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VICTORIA.

DEPARTMENT OF MINES.

RECORDS

OF THE

GEOLOGICAL SURVEY OF VICTORIA

(E. J. DUNN, F.G.S., Director).

Vol. I., Part 4.

ISSUED BY

W. R. ANDERSON, SECRETARY FOR MINES, UNDER THE AUTHORITY OF THE HON. D. McLEOD, M.P., MINISTER OF MINES.

By Authority:

J. KEMP ACTING GOVERNMENT PRINTER, MELBOURNE

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CONTENTS.

Page.

7. Dunn, E J., F.G.S. Report on the Proposed Sunnyside Tunnel, Mount Wills Gold-field, and on certain Reefs and Alluvial Workings in that District, with Plan and Section (Plate XXIII.) 233

28. Howitt, A. M. Report on the Edi—Myrrhee Turquoise Belt and the Chert and Jasper Beds near Tatong, County of Delatite, with Plan (Plate XXIV.) 239

29. Howitt, A. M. Report on Lignite Deposits near Mahaikah, County of Delatite, with Plan (Plate XXV.) 241

30. Howitt, A. M. Report on Wilkinson and Phelan's Alluvial Gold Mine, Whitfield South, County of Delatite, with Plans and Section (Plate XXVI.) 243

31. Howitt, A. M. Reports on the Phosphate of Alumina Beds near Mansfield, County of Delatite, with Plan (Plate XXVII.) 245

32. Whitelaw, O. A. L. Brief Report on the Mining Features of the Hoddle's Creek District, with Plan (Plate XXVIII.) 247

33. Ferguson, W. H. Report on Glacial Conglomerate of Supposed Jurassic Age, in Parish of Wonga, Wonga, near Foster, Southern Gippsland, with Plan (Plate XXIX.) 249

34. Kitson, A. E., F.G.S. Report on the Diatomite Deposits and General Geology of the Portland District, with Plan (Plate XXX.) 251

35. Kitson, A. E., F.G.S. Report on the General Geological Features of the Welshpool—Hedley District, with Plan (Plate XXXI.) 256

36. Dunn, E. J., F.G.S. Report on the Discovery of Auriferous Quartz at a depth of 4,156 feet in the New Chum Railway Mine, Bendigo, with Photograph (Plate XXXII.) 258

37. Mahony, D. J., B.Sc. Report on Rocks from Bendigo 258

38. Dunn, E. J., F.G.S. Report on the Homeward Bound, Perseverance, Bon Accord, Von Moltke, The Dyke and Mount Stanley View Reefs, Hillsborough, with Plan and Section (Plate XXXIII.) 263

39. Hall, T. S., M.A. Reports on Graptolites, with Plate, Figure and Map (Plate XXXIV.) 266

REPORT ON THE PROPOSED SUNNYSIDE TUNNEL, MOUNT WILLS GOLD-FIELD, AND ON CERTAIN REEFS AND ALLUVIAL WORKINGS IN THAT DISTRICT, WITH PLAN AND SECTION (PLATE XXIII.).

By E. J. Dunn, F.G.S., Director, Geological Survey of Victoria.

Situation.

The proposal is to drive a tunnel in from a point near the United Brothers battery, on Wombat Creek, towards the north-eastern corner of the John Bull lease. From the mouth the direction would be about W. 20 deg. S., or nearly at right angles to the strike of the country. The Antiope and United Brothers reefs would be cut in about the centre of their length, and the Gentle Annie reef would be cut on its northern end. The distance from the mouth of the tunnel to the first reef now worked—the Antiope—would be about 1,870 feet. To the United Brothers reef the distance from the mouth would be about 2,600 feet. To the Gentle Annie reef the distance would be about 4,000 feet.

Accurate levelling would have to be done to determine the exact amount of "backs" that such a tunnel would render available. Only rough measurements were taken, and from these it would appear that on the Antiope reef about 350 feet of "backs" below the bottom workings would be made available. At the United Brothers the "backs" below the ground already worked out would be about 250 feet. At the Gentle Annie reef several hundred feet of "backs" would be available if the tunnel were extended so far. This, however, would imply not only the driving of the tunnel through many hundreds of feet of unaltered granite, but also the sinking of several hundreds of feet through the same material. One argument used in favour of the tunnel is that in driving across the "country" lodes and veins that do not show at the surface might be cut. This, however, rarely happens.

Rocks.

Mount Wills is a granite mass rising to an altitude of 5,758 feet above sea-level. On the eastern flank schistose rocks prevail; they occur a few chains east of the Gentle Annie reef and continue easterly beyond Sunnyside. At the surface the granite is much altered, and as far down as the workings have penetrated the rock is still changed. About the least altered granite met with in the neighbourhood is in the Star of the West tunnel, but the heart stone, which is beyond the influences of the atmosphere and percolating waters, will be much harder than anything yet encountered.

Schists of silky appearance, knotted schists, &c., are prominent, and are undoubtedly the direct result of intrusions of granite acting on sedimentary rocks, apparently of Ordovician age. The strike of the schists where good observations were possible is about N. 20 deg. W. The beds are nearly vertical. Auriferous quartz reefs intersect both granite and schist "country."

Reefs.

A complicated system of fractures intersects the country at Sunnyside. Lode material fills some of these lines, but not continuously, for in working the reefs the walls are in some places in contact and no ore is present.

[*Report sent in 7th March*, 1905.]

Where ore occurs it is generally but a few inches thick, and consists of quartz, with sulphides of antimony, zinc, lead, iron, and copper, more or less thickly disseminated through it. Some free gold occurs, but more often it is combined with the complex sulphides. Spurs from the reefs branch off into the walls, and these are commonly even richer in gold than the ordinary lode material. In most cases one wall of the lode is well marked and smooth; the other is not defined, the ore being firmly attached to it and not separated by a joint.

There are two classes of lodes in this neighbourhood, locally distinguished as the "brown" and "blue" lodes. Most of the work so far done has been on the "brown" lodes. Quite a feature of the reefs on this field is the manner in which they branch off. Their general aspect suggests that the rocks have been fractured in different directions, and certainly at different times.

Three main lines of reefs occur, known as the Antiope or Moran, the United Brothers or Democrat, and the Gentle Annie or Samaritan. On each line a considerable amount of work has been done, principally by means of tunnels, and with very profitable results; for although the quartz reefs are, as a rule, small, they are usually rich, returning in some cases several ounces of gold per ton. Most of the reefs are but 3 inches to 9 inches thick. At the United Brothers mine a thickness of 3 feet of mixed "mullock" and quartz was sent to the mill, and in some places mixed material 7 to 8 feet in width was also sent there. From the surface the reefs have been worked to depths ranging up to 300 feet. Advantage has been taken of the mountainous nature of the ground, and tunnels have in most cases been used to work the reefs, but most of the ground available for this system of mining has now been worked out, and either shaft sinking or a deep level tunnel will have to be resorted to.

On the three lines of reefs the following mines are situate:—

Antiope Line.

Mt. Moran Mine.—This mine is worked by tunnels from the second tunnel up to the surface, for a length of over 400 feet along the reef. The quartz is about 3 inches thick. At the N. end of bottom level the reef dips W. at an angle of 70 deg. About 7 inches of quartz and commingled "country rock" are crushed.

Antiope Mine.—Two shafts have been sunk on this lease. The S. shaft is 140 feet deep to tunnel level, and 173 feet to bottom of shaft. The reef has been stoped to surface for 150 feet in length below, and 40 feet at. the surface. The lode worked was a "brown" lode. The northern shaft has been sunk 90 feet to the tunnel level and 100 feet below it. but payable ore has not been cut.

United Brothers Line.

Democrat Mine.—This is situate on the S. end of the same line as the United Brothers mine. It has been worked so far by tunnels, and over 400 feet of the lode stoped out above No. 2 tunnel to the surface.

Golden Fleece Mine.—This is also on the same line of reef, and by means of tunnels a considerable length of the lode has been stoped out.

Melbourne Democrat Mine.—This is on the same line. It is also worked by tunnels, and stoped out, in part, near the surface.

United Brothers Mine.—This is the principal mine on the field. It has the best crushing mill and appliances for treating the quartz; also air compressing plant for hauling winch and for rock-drills, and the mine has been worked more extensively than any other on the field.

The surface stone has been stoped out by means of two tunnels, 80 feet apart. In the bottom tunnel a blind shaft has been sunk 300 feet below the adit. The shoot of gold has been worked out for 100 feet below the adit, and partially worked out to the second or 200-feet level below the adit. At the 300-feet level a chamber has been cut, but no quartz stoped out. As worked near the surface the shoot of gold was over 1,000 feet long. From the bottom of the blind shaft to the level of the proposed tunnel the depth would be 150 feet. At present the blind shaft is full of water, but operations are proceeding for pumping this out and for driving N. and S. along the lode. The dip of the reef is E. in one part and W. in another.

Gentle Annie Line.

Samaritan Mine.—The reef has been worked through the whole length of the lease with good results. Much of the reef is stoped out above the level. The quartz vein is 3 to 4 inches thick; the "country rock" is granite. Portions of the lode channel have no ore. Much sulphide is present in the quartz, which averages about 1½ oz. per ton; this, of course, includes much of the wall of the lode. A western branch of the reef is being worked on the southern end of the lease, otherwise the shoots have been stoped out from the surface to the tunnel level. To drive another adit would be expensive, and so the mine is nearly at a standstill, though the reef below the present level should be just as profitable to work as above it.

Meerschaum Mine.—Here a tunnel has been driven in to the reef and level extended along reef for over 500 feet. The strike of the reef is N. 15 deg. E.; dip about 44 deg. to W. The thickness of the quartz is 4 inches to 12 inches, average 5 inches; present yield of gold about 2 ozs. per ton. Above this tunnel all the stone is stoped out; below it there is a mass 90 feet in depth available from the Gentle Annie tunnel.

Gentle Annie Mine.—As with the rest of the Gentle Annie line of reef this "country rock" is granite. The thickness of the reef is about 2 inches. The reef dips westerly at 65 deg. It is worked right through the length of the lease above the level, and a winze has been sunk below. The veinstone on this line is highly mineralized and very complex, containing sulphides of zinc, lead, iron, copper, antimony, &c. There is every appearance that the lode will continue downwards, but the country is certain to become harder in depth.

Star of the West Mine.—This is on the northern end of the line of reef. A level has been driven for about 400 feet along the reef, and a crosscut connects with the surface. The quartz reef is from 3 inches to 6 inches thick. Above the level the quartz is stoped out; below it a winze, 35 feet deep, has been sunk.

So far as work has proceeded on the principal lines of reef, the indications are that they are of a permanent nature, and that they will continue persistently downward. Though not, as a rule, of great width, and in some cases only a few inches wide, the reefs have proved profitable to work.

The ore is of such a nature that much of the gold is locked up in sulphides, and one of the problems awaiting solution is how to deal successfully with the complex concentrates. In many cases these are not even saved, and when saved they have to be sent long distances for treatment.

The Tunnel.

The tunnel proposed would be driven through schist country for some distance past the United Brothers reef. At first the rock would be easily and cheaply dealt with, as it is weathered, but as the tunnel increased in length firmer and harder material would be encountered, because the depth from the surface increases, and also because of the approach to a known mass of granite.

To be of any use as an ore-way the tunnel would have to be wide enough for a double line of rails, say, 8 feet wide, and if horse traction is to be employed it would have to be 7 feet high. A material consideration in such matters is the cost. Locally it is estimated at £2 per foot. The first hundred feet, or so, might possibly be done at this price, but, taking the 1,850 feet which would be required to cut the nearest reef, the Antiope, I consider that £4 per foot would be a reasonable price, and very much doubt if a contractor would undertake it for that sum. Rock drills would be required, and this means the installation of air compressing plant and accessories that would cost £2,000. After the first 2,000 feet, the cost of driving would be greatly enhanced, and the rock would be very hard close to the granite contact. If continued past the United Brothers reef hard unaltered granite would be entered, and the work would be very costly.

One of the principal functions of a tunnel such as is proposed is that it shall drain the lode or lodes it is driven to intersect. In the present case the tunnel would but partly fulfil this office, for it is fully proved in the existing workings that cutting a lode does not result in draining it. Even the driving of levels along the course of the lode does not result in draining the lode overhead. In some cases where a winze has been sunk, and a level driven right underneath, the winze is not drained, although only a few feet intervene between the bottom of the winze and the drive. It is a feature of these lodes that they appear to be intersected at frequent intervals with divisions that prevent the water from flowing freely. In shaft sinking this is an advantage. Another purpose that such a tunnel is supposed to serve is as an ore-way, by means of which the ore can be cheaply and freely transported from the lode to the recovery plant. In this case the ore would have to traverse a cross-cut of half-a-mile, and as much further as the mine might be from the end of the cross-cut. It is doubtful if this could be done as cheaply as by hauling the ore to the surface and then running it down the slope by gravitation to batteries situated close to the mines. To make the necessary connexions from the several mines to the end of the cross-cut would not only involve a heavy expenditure, but also the obtaining of rights of way through intervening leases.

After duly weighing any possible advantages as against the certain cost of this proposed tunnel, I do not see that it is likely to benefit the mining interest of Sunnyside in a way at all commensurate with the outlay that would be incurred. Although unable to advise the construction of the proposed tunnel, at any rate at this stage, I certainly consider this field to be well deserving of all the help the Department of Mines can give. As a gold producer it is important. The official statistics of yields from some of the principal mines at Sunnyside are:—

	Quartz. Tons.	Gold. Ozs.
Samaritan	755	1,088
Meerschaum	1,306	5,593*
Gentle Annie	546	2,761
Star of the West	68	358
United Brothers	5,200	34,070
United	419	313
Antiope	3,517	4,336
Mt. Moran	914	2,501
Democrat	11,441	11,266
	24,166	62,286

* Incomplete returns.

Much of the work accomplished on this field has been done under adverse conditions and without outside help. Owing to the geographical position, the cost of food, of machinery, and of everything that has to be transported, is very heavy, and forms a considerable addition to the charges in winning the gold. In no way could this district be more generally benefited than by improving the roads leading to it. The cutting of tracks, also, to outlying places where promising reefs are discovered would be a great boon.

Shaft sinking will probably be more generally resorted to than tunnels in future development, and some assistance might perhaps be given towards sinking a shaft on one of the lodes to prove the continuance downwards of the lode and its value at deeper levels.

My thanks are due to Mr. McInerheney and the members of the Progress Association for much assistance and information supplied while examining the field.

ADDENDUM.

Besides the mines that are directly associated with the tunnel scheme there are many others that are well deserving of a test in depth. As a rule they are more suitable for small parties of miners than for companies to work. Near the top of Mount Wills and in granite country a considerable amount of work has been done with profitable results. Other granite areas should be tried.

The Wombat Reef.—This occurs at an altitude of 5,300 feet above sea level. The reef is vertical, and strikes N. and S. The quartz is highly mineralized and about 4 inches thick, yielding about 5 ozs. per ton. The gold is worth £3 6s. to £3 10s. per oz. The Whip Shaft is 50 feet deep. The reef is very irregular, and consists in places of four or five separate fissures in the granite, each with a thin auriferous vein of quartz. Some of these small veins are very rich in gold, but a great deal of "country rock" is sent to the crushing plant with the quartz. The reef dips W., and is traceable for more than half-a-mile on the surface. A parallel reef runs 30 feet to the E. The shoot of gold at the Whip Shaft is 50 feet long and pitches N.

Sunny Heights Mine.—This is 5,350 feet above sea level. The strike of the reef is N. and S.; dip to W. at 70 deg. The country is granite. The reef has about 4 inches of quartz, and is worked right through the length of the lease, the deepest workings being about 45 feet from the surface.

Mountain Chief Mine.—This is a continuation of the Sunny Heights reef northward. It has been worked for 60 feet in length. Another reef with strike to N.E., and dip 25 deg. to N.W., occurs here. This mine is 5,600 feet above sea level, and is said to be the highest gold mine in Victoria.

Other reefs have been worked further to the W., but they were not visited. Most of these reefs at shallow depths carry sulphides in varying quantities and of varying values. The concentrates from these are in many cases exceedingly rich in gold, and at present there is no local plant for treating them. The heavy transport and other charges tend to drive away the miners. A small cyanide plant is being erected to deal with these concentrates. The ores being so complex, an effort should be made to assist by having samples from various mines tried, and also by carrying on experiments as to the best way to deal with such intractable ores.

It is a noticeable feature that pegmatite is very commonly present where the reefs are auriferous, both at Sunnyside and at Glen Wills. The relations have yet to be worked out.

The Marie Bertha Reef, Lightning Creek.

About 12 miles in a northerly direction from Sunnyside is Mr. Mulhausen's lease on Lightning Creek, 2,675 feet above sea level, and here is a small stamp mill. From this level to the top of the spur on the western side of the creek—3,150 feet above sea-level—dykes of diorite, in a decomposed condition, and quartz veins cut through the slate and sandstone country. The dykes range from 10 to 5 feet wide, and four of them occur on the lease. At the junction of the dykes with the slate and sandstone country the latter is seamed with quartz veins that carry payable gold in many places. The auriferous material is, in some cases, 4 to 5 feet wide, and there appears to be a great quantity available. A belt of Ordovician strata, with diorite dykes, runs northward from this and shows on the road near, and west of the junction of the Snowy Creek with the Lightning Creek.

The Razorback Reef.

About 5 miles N. from Sunnyside a rough, broken ridge of high country occurs. The top of Razorback is about 4,700 feet above sea level. This reef occurs on the southern slope, and 400 feet below the top. The country rocks are slate and sandstone of Ordovician age. A decomposed diorite dyke cuts through the country. Through this quartz veins are numerous. The lode strikes N. 35 deg. E., and dips E. 35 deg. S., at 70 deg. The thickness of mixed quartz and diorite is from 2 to 4 feet. Two tunnels have been driven into this lode and about 200 tons of ore taken out. Parcels of ore are now being taken to Sunnyside by pack-horse for crushing. The lode should certainly have more work done upon it. The quartz is heavily mineralized, and this constitutes the main difficulty, as at present such ores cannot be dealt with properly.

Alluvial Workings.

Lightning Creek was worked for alluvial gold in very early times, and is reported to have been very rich in some parts. Alluvial deposits occur at varying heights above the creek, and some of the old points are said to have paid handsomely. Judging by the manner in which the alluvial material has been removed down to the bed rock on the slopes above the creek, I should expect that in places gold would be found on these slopes in the joints and crevices of the rock. In the same manner, it seems most unlikely that the original miners took up the rough bottom in the creek bed, and some gold should still be there, deep in the crevices of the slate and sandstone bottom.

Other creeks largely worked for alluvial gold in the neighbourhood are Christmas Creek, Mopoke Creek, Peg-Leg Creek, and Merrimac Creek. The very fact that such an extensive area has been worked for alluvial gold speaks strongly in favour of the existence in the adjacent hills of the lodes which supplied the gold.

[*Addendum sent in* 10*th March*, 1905.]

REBECCA

MOUNTAIN CHIEF

WALLABY

IVEY'S FREEHOLD

SNOWY HEIGHTS

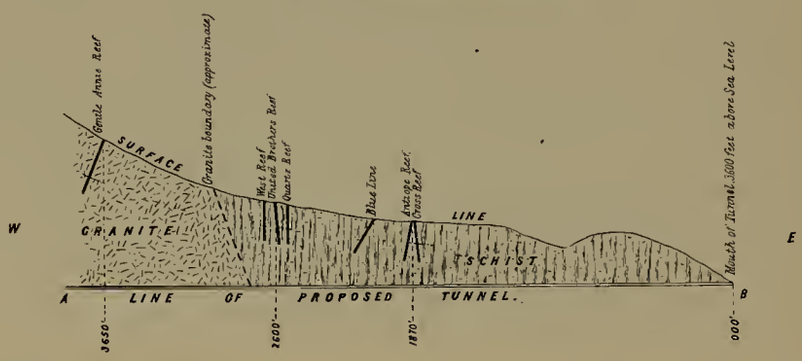
WOMBAT

MIZPAH

Mt. WILLS Trig. Station △ 3758'

Sketch section of PROPOSED TUNNEL AT SUNNYSIDE.

SCALE — Horizontal, 100 400 300 200 100 0 500 FEET.
Vertical,



Sketch plan of LEASES AND AURIFEROUS REEFS at SUNNYSIDE, Mt. WILLS GOLDFIELD, Showing position of Proposed Tunnel.

SCALES 4 2 0 2 10 15 Chs
100 200 100 0 500 1000 Feet

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REPORT ON THE EDI-MYRRHEE TURQUOISE BELT AND THE CHERT AND JASPER BEDS NEAR TATONG, COUNTY OF DELATITE, WITH PLAN (PLATE XXIV.).

By A. M. Howitt.

This geological report has been made on a cursory examination of the turquoise belt in two localities, Edi and Myrrhee, which was made to determine whether the turquoise occurred in beds geologically similar to the Mansfield chert and phosphatic beds. A sketch geological report on some sedimentary beds near Tatong, in the parish of Moorngag, county of Delatite, is also furnished.

On the accompanying sketch geological plan of portion of the county of Delatite between the Broken and King Rivers there are shown:—

(1) The Edi-Myrrhee turquoise belt.
(2) The chert and jasper beds near Tatong.
(3) The approximate boundaries of the surrounding geological formations, taken from rapid sketch work done by Messrs. Ferguson, Allan, and myself for the new geological map of Victoria, recently published.

The Edi-Myrrhee Turquoise Belt.

Edi.

An examination of the sedimentary beds of the turquoise belt and adjacent country shows that there are no beds geologically similar to the Mansfield chert beds, those noted being:—

(*a*) Black graphitic slates, occasionally containing pyrites, either as nodules, solid veins or disseminated crystals. These beds are fossiliferous, containing graptolites.
(*b*) Narrow beds of grey arenaceous slate.
(*c*) Crushed brown and grey slates.
(*d*) Brown siliceous sandstones.

The turquoise veins occur only in the beds (*a*) and (*b*), which are crushed in places. The average strike is N. 35 deg. W., and the dip to N.E. at an angle of 80 deg. The turquoise veins, some of which are $\frac{1}{4}$ inch in thickness, run irregularly with the strike, sometimes crossing the beds, and are more recent than the quartz veins and the veins and nodules of pyrites, as is seen in a specimen which shows a nodule 1 inch in diameter, bisected by a fault, on the plane of which a turquoise vein has formed.

Fossils.

From the black graphitic slate beds faint sheeny graptolites, visible only in a certain suitable light, were obtained. These have been examined and reported upon by Mr. T. S. Hall, M.A., as follows:—

"Specimens 344-365, Turquoise mine, Mount Avis, Edi.—Nos. 344, 345, 347 and 350 are, I think, branches of a member of the family *Dichograptidæ*, perhaps *Didymograptus*. They do not, I think, belong to the family generally known as *Leptograptidæ* nor to the *Monograptidæ*. They are, however, extremely indistinct. Numbers 346, 353, 356, 358, 360, 361 and 362 are indistinct *Diplograptidæ* of indeterminate character; while Nos. 348, 351, 354, 363 and 365 are referable to *Diplograptus* itself, and 349, 353, 357 and 364 are *Climacograpti*. A second specimen of 351 is a *Glossograptus*. I doubt if 359 is organic. In no case can specific determination be suggested. If the generic determinations of *Didymograptus* and *Glossograptus* be correct, and they seem to be, then the age of the beds may be put down as Upper Ordovician."

Although no phosphatic rocks were met with in the turquoise belt, a sample of ironstone, from a few miles further east, yielded 15 per cent. of orthophosphoric acid, as shown by the following analysis made by Mr. P. G. W. Bayly, at the Mines Department Laboratory.

No. 344. (Qualitative analysis).

Iron peroxide	Fe_2O_3	...	Not determined.
Alumina	Al_2O_3	...	Not determined.
Lime	CaO	...	(Trace)
Magnesia	MgO	...	(Trace)
Phosphoric anhydride	P_2O_5	...	(About 10%)
Orthophosphoric acid (calculated from the P_2O_5 ...	H_3PO_4	...	(About 15%)

No. 343. (Assay).

Pyrites vein occurring in the graphitic slate with the turquoise.

Gold	(Au)	...	(Trace)
Silver	(Ag)	...	4 dwts. per ton of sample.

Myrrhee.

From Edi I proceeded to Ryan's Creek on the north-eastern extension of the turquoise belt in allotment 30, parish of Myrrhee. Here the beds in which the turquoise veins occur are geologically similar to those at Edi, and exhibit no lithological resemblance to any of the beds associated with the Mansfield cherts. The turquoise-bearing belt from Edi to Ryan's Creek appears to have an approximate parallelism to the main porphyry formation. Sheeny graptolites were again obtained here, and reported on by Mr. Hall as follows:—

"Nos. 336-343. Turquoise Mine, Ryan's Creek, Myrrhee.—Specimen 338 contains examples of *Diplograptus* sp., and 339 a *Dendrograptus*, but the state of preservation is too poor to allow of closer determination. There appear to be indefinite traces of graptolites on the other slabs. The evidence submitted is not sufficient to give the age of the containing rocks. The probability is that they are either Upper Ordovician, or else Lower Silurian."

Some other specimens, examined by Mr. Hall in 1898, from Ryan's Creek, Myrrhee, were classed as of Upper Ordovician age. There is no doubt that the Edi and Ryan's Creek beds are of the same geological age, and portions of the same turquoise-bearing belt. They are probably much younger than the wavellite-bearing chert and phosphate beds at Mansfield.

The Tatong Cherts and Jaspers.

At about one mile south-west of the Tatong township, and nine miles south-west of the Ryan's Creek turquoise belt, there is an area of highly indurated sedimentary beds, which I examined on my way back from the turquoise mines to Benalla. I made notes on outcrops in the following three localities:—

(*a*) Allotment 74, parish of Rothesay.
(*b*) Allotment 23, parish of Moorngag.
(*c*) Allotment 46, parish of Moorngag.

At locality (b) specimens of the various beds were procured, and the appended notes made.

Geological Sketch Plan of Portion of the COUNTY of DELATITE, between BROKEN and KING RIVERS, showing EDI–MYRRHEE TURQUOISE BELT and CHERTS and JASPER BEDS near TATONG.

SCALE-Two Miles to One inch.

TATONG

SAMARIA

ROTHESAY

MYRRHEE

TOOMBULLUP NORTH

MOORNGAG

WHITFIELD

EDI

GRAPTOLITES

TURQUOISE

APPROX. MAIN LINE OF TURQUOISE

TURQUOISE GRAPTOLITES

NOTE-The geological boundaries are adopted from the unpublished plan of the rapid survey of the county of Delatite, by W.H. Ferguson, assisted by A.M. Howitt.
The boundary between the Silurian and Ordovician beds has not been defined.

REFERENCE

- UPPER CAINOZOIC TO RECENT (Gravels, sands, alluvium).
- EOCENE (Basalt)
- EOCENE (Gravels, etc.)
- CARBONIFEROUS (Upper) (Conglomerates, sandstones, shales, of glacial origin).
- UPPER DEVONIAN (Conglomerate).
- LOWER DEVONIAN (Porphyry, etc.)
- LOWER DEVONIAN (Granite).
- SILURIAN (Sandstones, shales, etc.)
- ORDOVICIAN (Sandstones, slates, etc.)
- PRE-ORDOVICIAN (HEATHCOTIAN) (Cherts, jaspers, etc.)

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The beds are of various colours and exhibit great induration, in some cases being red jasper, black cherts and green vitreous cherts, containing disseminated pyrites and approaching chalcedony in places. Less indurated grey beds, showing manganese oxide on joint planes, were also noted. The strike of the beds is N. 40 deg. W., but no dips were obtainable. A green hornblendic dyke, containing calcite and finely disseminated pyrites, trends northward through allotment 23, and across the S.W. corner of allotment 25, parish of Moorngag, cutting the jasper beds, and apparently accounting for the green colouration of the vitreous cherts, which have chalcedonic veins along its course. I do not think the beds owe their induration to this dyke, which is only a few feet wide, and which, apart from making a slight alteration along its course, does not affect the beds away from it. As the sketch plan indicates, large areas of Lower Devonian porphyries occur to the south-east, but apparently do not account for the induration of the chert beds. No fossils were obtained, but the lithological evidence points to their similarity to the cherts and jaspers at Heathcote, for hand specimens from Moorngag can be well matched with the Heathcotian black cherts and red jaspers. The Dookie area of cherty rocks lies about 30 miles to the north-west of Moorngag, and the Mansfield cherts 20 miles to the south.

Although no conclusive evidence in the shape of fossils, &c., can be obtained, I consider that for the present the beds may be classed as probably of Heathcotian age. I had neither the opportunity nor time to define the exact boundaries of these Tatong cherts and jaspers, so have marked on the plan an approximate boundary taking in the three localities already referred to.

[*Report sent in 6th November*, 1905.]

REPORT ON LIGNITE DEPOSITS NEAR MAHAIKAH, COUNTY OF DELATITE, WITH PLAN (PLATE XXV.).

By A. M. Howitt.

The coal seam described in this report is situated on Thomas Facey's allotment No. 107, parish of Whitfield South, formerly owned by D. Maroney.

Locality No. 1.

The seam was found some years ago, whilst sinking for water near a spring, and here an oval-shaped prospecting hole has been sunk to a depth of 17 feet.

I could not see the seam here, as the hole was full of water, but I carefully examined the material taken out. This consists of ligneous clay, containing leaf fossils (similar to another outcrop which will be referred to later on). black ligneous sand, brown clay and the seams of lignite, composed of carbonized leaves, twigs and wood, containing iron pyrites on joint planes and in nodules. Mr. Wilkinson, who was present, and who was one of those last working in the lignite, informed me that at about 14 feet from the surface a thin layer, 1-10th inch to about 2 inches in the eastern side, was cut; then 1 ft. 6 in. of ligneous clay was passed through, and the lower layer or seam of ligneous casing and lignite was exposed for over 2 feet, as now appears in the bottom. These ligneous clays, sands and lignite dip under the basalt, which caps the ridge, and are resting on sandstones of Lower Carboniferous age.

LOCALITY NO. 2.

At a point about 20 chains further south, at a lower altitude than the main beds, similar ligneous clays, containing leaf fossils, were examined in section, where a steep fern gully has exposed them below the basalt, as in sketch section—Fig. 1.

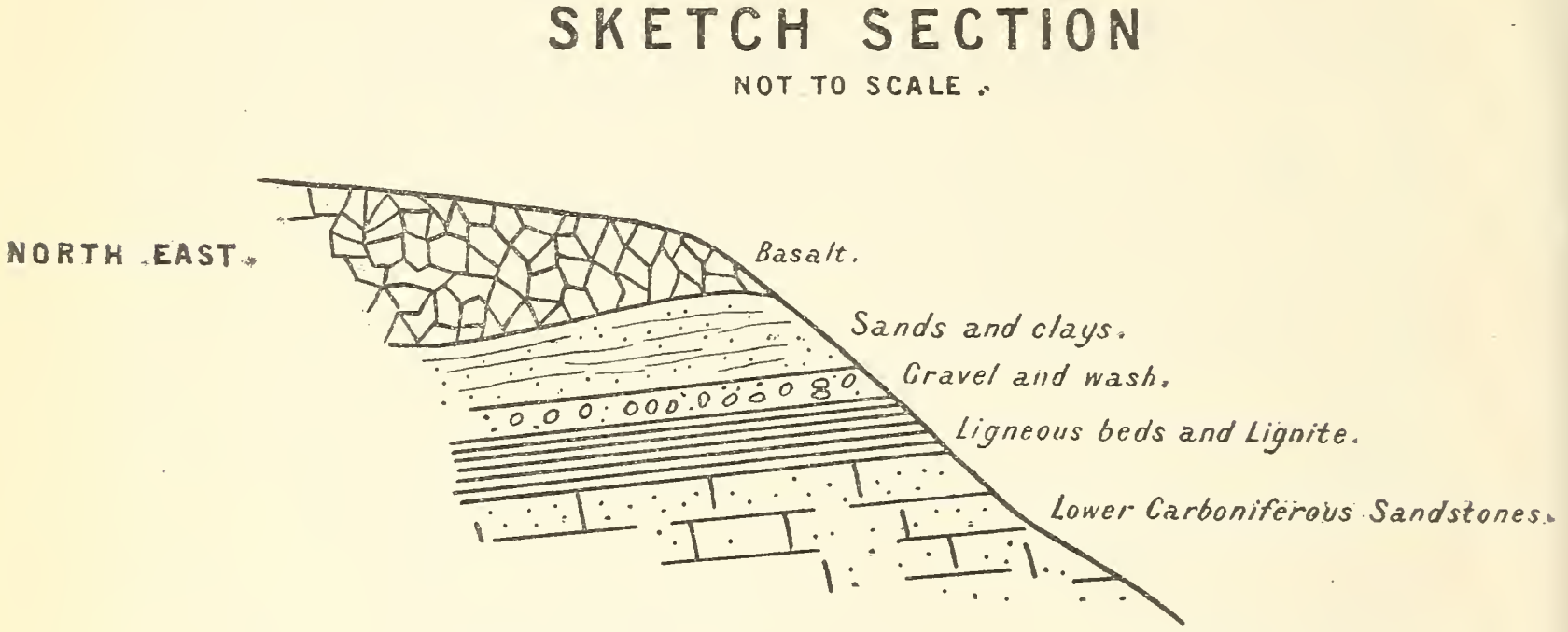


Fig. 1.

The beds are nearly flat, only dipping slightly N.E. into the hill, and are directly below the gravel and wash. The basalt is on the ridge above, while below the ligneous beds are the Lower Carboniferous sandstones. I consider these lignites and leaf beds to be similar to the sub-basaltic lignites and ligneous clays of the Dargo High Plains, &c., and probably of Eocene age. The ligneous clays and leaf-beds may occur over a large area under the basalt, as already they have been noted in three localities, two in Facey's allotment and a third in P. Egan's allotment No. 50A, parish of Dueran East, a little further south, under the same basaltic area; but the purer lignite would probably only occur occasionally in layers or seams in the ligneous clays, and, therefore, not be of great extent.

In a report on this occurrence of lignite in Facey's allotment, published in Prog. Rept. Geol. Surv., Vict., No. IX. (1898), p. 45, Mr. James Stirling, formerly Government Geologist, says:—"A cursory examination was sufficient to disclose the nature and age of the deposit, as consisting of several small layers of dark-coloured lignite. . . ." Later on he states: "This lignite deposit is of no commercial value whatever."

The recent analysis (No. 355), made at the Mines Department Laboratory, was of clean lignite, and is as follows:—

	%
Moisture	23.55
Volatile hydro-carbons	20.32
Fixed carbon	38.58
Ash	17.55
	100.00

Pyrites assayed apart.

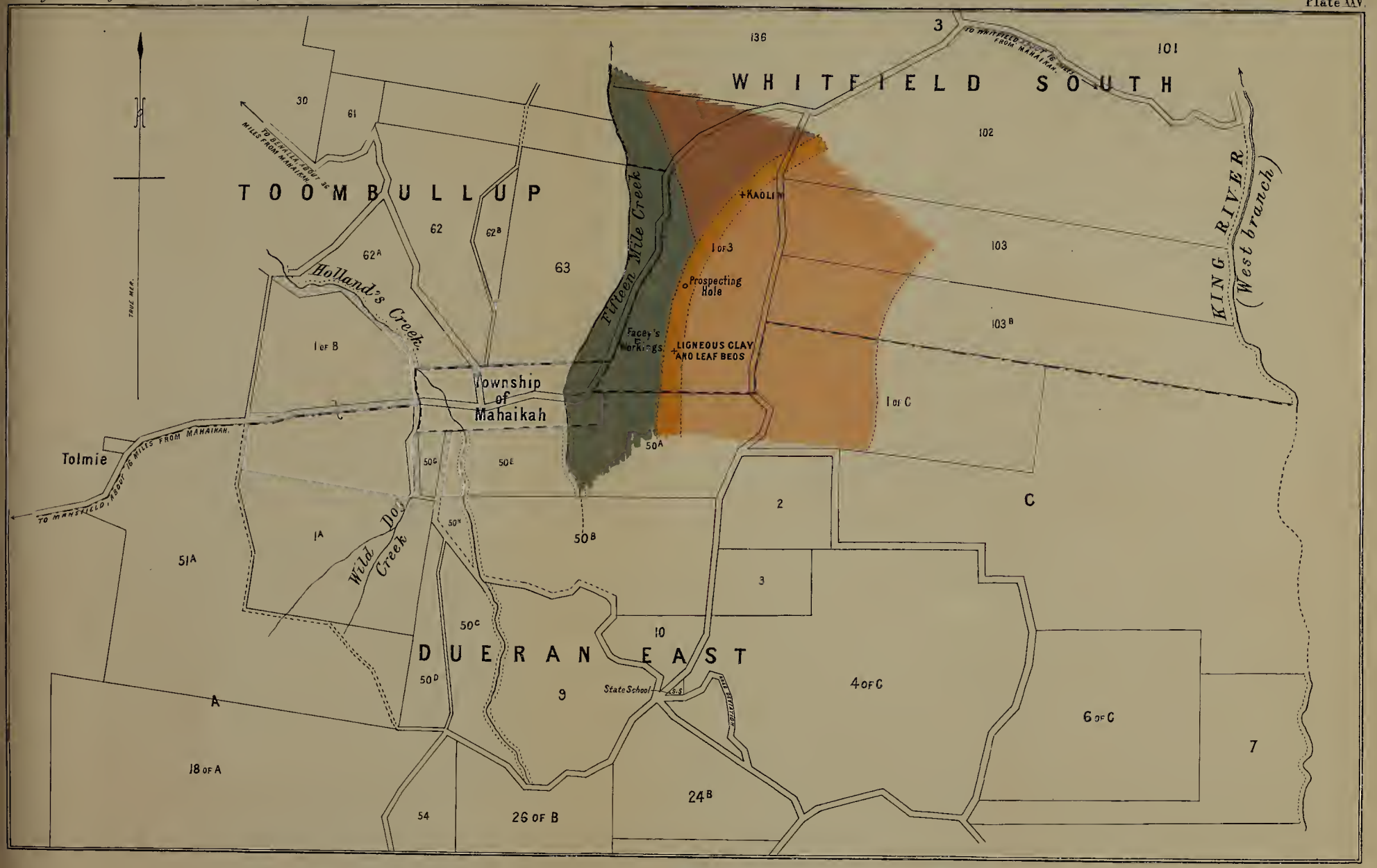
I have obtained specimens of fossil leaves, and a fresh sample of the lignite for further analysis, if required. On the whole, I consider that at the present time these lignite deposits are of no commercial value. I may

Geological sketch plan of

LIGNITE DEPOSITS near MAHAIKAH,

COUNTY OF DELATITE.

Geological Survey of Victoria, Records, Vol. I, Part 4.



REFERENCE.

- LOWER DEVONIAN. (Porphyry).
- LOWER CARBONIFEROUS? (Sandstones, etc.).
- EOCENE. (Ligneous clays, sands & gravels).
- EOCENE. (Basalt).

SCALE - 40 Chains to One inch.

BRITISH MUSEUM
G.
D.
NATURAL HISTORY

add, however, that kaolin (pipeclay), a sample of which I collected, occurs under the basalt in several localities, and should it prove of good quality and of sufficient extent there might, in the future, be a possibility of utilizing the lignite in the baking of pottery, as has been successfully done in Devonshire, England, where lignite of bad quality for other economical uses, containing iron pyrites, has been so used.

[*Report sent in 8th August*, 1904.]

REPORT ON WILKINSON AND PHELAN'S ALLUVIAL GOLD MINE, WHITFIELD SOUTH, COUNTY OF DELATITE, WITH PLANS AND SECTION (PLATE XXVI.).

By A. M. Howitt.

The alluvial mine of Messrs. Wilkinson and Phelan is situated on the southern side of a small creek, which runs into the Fifteen Mile Creek, on the Toombullup plateau, between Mansfield and Whitfield. It has been reported upon previously by Messrs. W. H. Ferguson, E. H. Goodenough and H. Davidson in connexion with applications under the Mining Development Act. These reports were made when Murray Brothers held the ground, and they received £200 to develop the mine by means of adits.

Geology.

A very dense basalt of Older Volcanic (Eocene ?) age caps the hill, covering sub-basaltic sands, clays and gravels, which rest on a bedrock of quartz-felspar-porphyry and garnetiferous quartz-mica-diorite—[see Fig. 2]. A good depth of surface soil covers the rocks all over the locality.

Workings.

On the northern side of the gully some old shallow alluvial workings can be seen, and on the southern side a great amount of work has been done, including several adits driven in a southerly direction to catch the auriferous wash, as it dips under the basalt. Little success, however, has attended any of the past work, which has nearly all been done by Messrs. Murray Brothers, the late prospectors of the ground. In this report the adits are numbered 1 to 5, in a direction from east to west.

Adits Nos. 1, 2 and 3 are only partly accessible at present, and were abandoned after being driven about 50 feet, and meeting auriferous wash dipping into the hill in each case, so I was informed.

Adit No. 4 (see Plate XXVI.) was driven about 160 feet by Messrs. Murray Brothers, partly with assistance under the Mining Development Act. It passed through sands and clays into porphyry. In the face at the time of inspection the wash was of water-worn quartz, quartzite and iron-stained pebbles; it dips at an angle of 9 deg. to south into the hill. There is about 1 foot to 2 feet of wash, from which a good prospect of water-worn and flat gold was washed in my presence. A prospect also from the headings showed a fair prospect of finer gold. The bedrock porphyry is fairly hard. There is a very strong inflow of water, which may indicate that the deep channel is not far below the level of this adit.

Adit No. 5 (see plan, Plate XXVI.).—This is the main lower adit, and starts about 30 feet below, 100 feet north of, and a little to the east of adit No. 4. The driving was through clay, sands and porphyry, being very hard in the later portion of the adit. At about 80 feet in there was an inflow of water, which may indicate a narrow alluvial channel, or a

terrace run of wash. The adit was discontinued at 140 feet in hard quartz-mica-diorite, and for some inexplicable reason the last 25 feet or so was gradually raised at an angle to the proper level, so the bottom will have to be straightened up before any further work can be done. This work was carried out while Murray Brothers were receiving Government assistance, but the deep ground was not reached, as work was abandoned when the Government grant was exhausted.

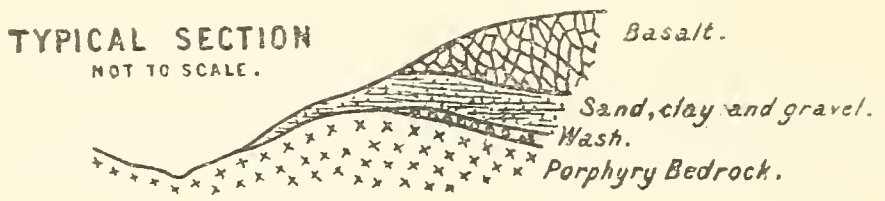


Fig. 2.

The present prospectors have taken up the ground as a prospecting area of about 500 square yards, and have already done four months' good work in cleaning up the adits and shafts, cutting a race, &c. They have also sunk a shaft to 30 feet through sand, clay and a few loose boulders of basalt, apparently the fringe of the basaltic formation; the last 7 feet of the shaft had to be closely timbered. A prospect from the headings showed a sample of flattened gold.

Up the hill, 288 feet further south, there is another shaft, now partly full of water, and I am informed that there was a thickness of 18 feet of sands and clays, and then solid basalt; total depth, 22 feet.

Future Work.

The prospectors intend to test the place where the inflow of water is in the lower adit; then to work in the No. 4 adit from a point some distance back from the present face, and go in a south-westerly direction, so as to try and avoid the broken ground, and, if possible, operate on the wash, and finally straighten the lower adit, and continue it to the deep ground.

Conclusion.

The inspection shows that there is auriferous wash dipping into the hill under the basalt, as proved by No. 4 adit; and the prospects are sufficiently good to warrant further work being done to prove the deep ground by means of the lower adit, as was the original intention. The deep channel may be as shown in trend of bedrock A^1. on section (see Plate XXVI.) as the inflow of water in No. 4 adit is very strong, indicating, perhaps, that the gutter is not much lower; and, if so, the lower adit could be safely extended and rises put up at suitable intervals after boring up to the wash. But then, again, the ground might dip on past the level of the lower adit, as shown in trend of bedrock B^1 (see Plate XXVI.). Therefore, before further work is done in the lower adit it would be more satisfactory to prove how the bedrock does trend, and this could be done by further sinking the 22-feet shaft, say, another 100 feet, or less if the bedrock rises; or, better still, to have a few hand bores put down to define the bedrock and deep channel. The basalt might be 50 feet or so in thickness. Even if the deep ground has the assumed trend of bedrock A^1. the adit would have to be driven at least 150 feet, and would probably cost £2 a foot. Timber is plentiful, but has to be carted a mile. Water is sufficiently plentiful for all requirements.

[*Report sent in 24th August*, 1904.]

Sketch Geological Plans and Section of WILKINSON and PHELAN'S ALLUVIAL GOLD MINE, WHITFIELD SOUTH, COUNTY of DELATITE.

REFERENCE.

Lower Devonian. (Porphyry). Eocene. (Sandy clays and gravels). Eocene. (Basalt).

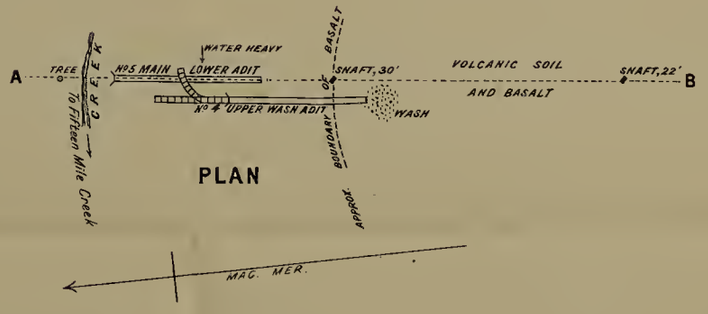
Scale — 40 chains to 1 inch.

PLAN OF LOCALITY.

SKETCH SECTION AND PLAN OF MINE.

Scale — 160 feet to 1 inch.

SECTION, LOOKING EAST.



PLAN

NOTE. Three other adits have been driven, and are situated east of No 5 adit.

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D.
G.
NATURAL

REPORTS ON THE PHOSPHATE OF ALUMINA BEDS, NEAR MANSFIELD, COUNTY OF DELATITE, WITH PLAN (PLATE XXVII.).*

By A. M. Howitt.

Preliminary Report.

These deposits of wavellite-bearing rocks, rich in phosphate of alumina, were discovered by me whilst engaged on the survey of quarter-sheet No. 45, N.E. (new series), in the Mansfield district. They occur on a hill sloping to Ford's Creek, at the junction of the Preston and Race-course roads, near allotment 4, parish of Loyola, county of Delatite, three miles by good road from the Mansfield railway station.

Geology.

The phosphatic deposits occur in altered sandstones and dark grey to black cherts, which are much contorted and crushed.

Occurrence and Extent.

The phosphate of alumina is richest in a white to grey fossiliferous rock, which occurs in mass, and sometimes lenticular shape, apparently interbedded with dark grey to black cherts. This white rock is intersected by veins of wavellite, showing its typical radiating structure. One specimen was procured showing a thin vein of turquoise. The formation of cherts and phosphatic rock can be traced for about fifteen chains in a westerly direction, with a width of about two chains. There should be a large quantity available, but further information as to this point could probably be furnished after another inspection. The wavellite may be found to be more plentiful at a depth, away from surface decomposition. The high inclination of the enclosing beds may point to the downward continuation of the phosphatic rock.

Finding both wavellite and turquoise in the formation, and seeing that these minerals usually contain about 34 per cent. and 32 per cent. of phosphoric acid respectively, I procured samples and forwarded them for analysis to the Departmental laboratory.†

General.

The land on which the phosphatic rocks occur is freehold, having been sold in 1881 and 1886. Should the material in a pulverized form prove to be of agricultural value it could be worked by open cuts and transported to the Mansfield railway station, which is only three miles distant by good road. I may also state that timber is fairly plentiful, and water only fifteen chains away in Ford's Creek, which would be advantageous for mining purposes.

In conclusion, it may be stated that the well known Loyola limestone quarries are only four miles distant to the south-south-west, as shown on plan. A rapid examination of the country between the phosphate of alumina and the limestone area might be warranted to find whether or not there are any deposits containing phosphoric acid and lime in combination, which might be of value for the manufacture of superphosphates.

[*Report sent in 9th March*, 1904.]

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* Reprinted from the Annual Report of the Secretary for Mines for year 1904, pp. 117–118.

† Results of these analyses appear in the Further Report, on the following page.

Further Report.

I have the honour to submit a further sketch plan and report on the phosphate beds near Mansfield, dealing more fully with the geology, and including notes on some new deposits half-a-mile S.E. of the original find.

Since my recent more thorough examination of both the original and the new outcrops, I am able to more fully describe the chert and phosphate beds, and to state that they are much older than Silurian, probably as old as Cambrian.

On the eastern portion of the plan are shown the Carboniferous rocks, which have the Silurian and Cambrian (?) ones underlying them. The Silurian beds are regular in strike, and consist of conglomerates, hard siliceous sandstones, coarse ferruginous sandstones and green to brown shales. The strike is 135 degrees, and the dip to south-west at 75 degrees. Encrinite ossicles were noted in the conglomerates.

Cambrian (?).—As seen in allotment 14B, parish of Loyola, the phosphatic and chert beds exhibit great contortion, and are tortuous in their strike; but where taken, as shewn on sketch plan, their strike is 280 degrees and dip southerly at 45 degrees. Wavellite occurs in veins in the phosphatic beds, and on joint planes in the cherts.

During my last examination I traced a new outcrop of the chert beds in allotments 16A and 16B, parish of Loyola, and here the phosphatic beds are narrower, much darker, and the black and green cherts more exposed than those in allotment 14B. No wavellite was noted in them, but I found fossil fragments of trilobites and brachiopods in a grey phosphatic bed. Professor Gregory, D.Sc., F.R.S., has undertaken the examination of a collection of the fossil fragments. which, when completed, will probably afford sufficient palæontological evidence to define the exact geological age of the beds.

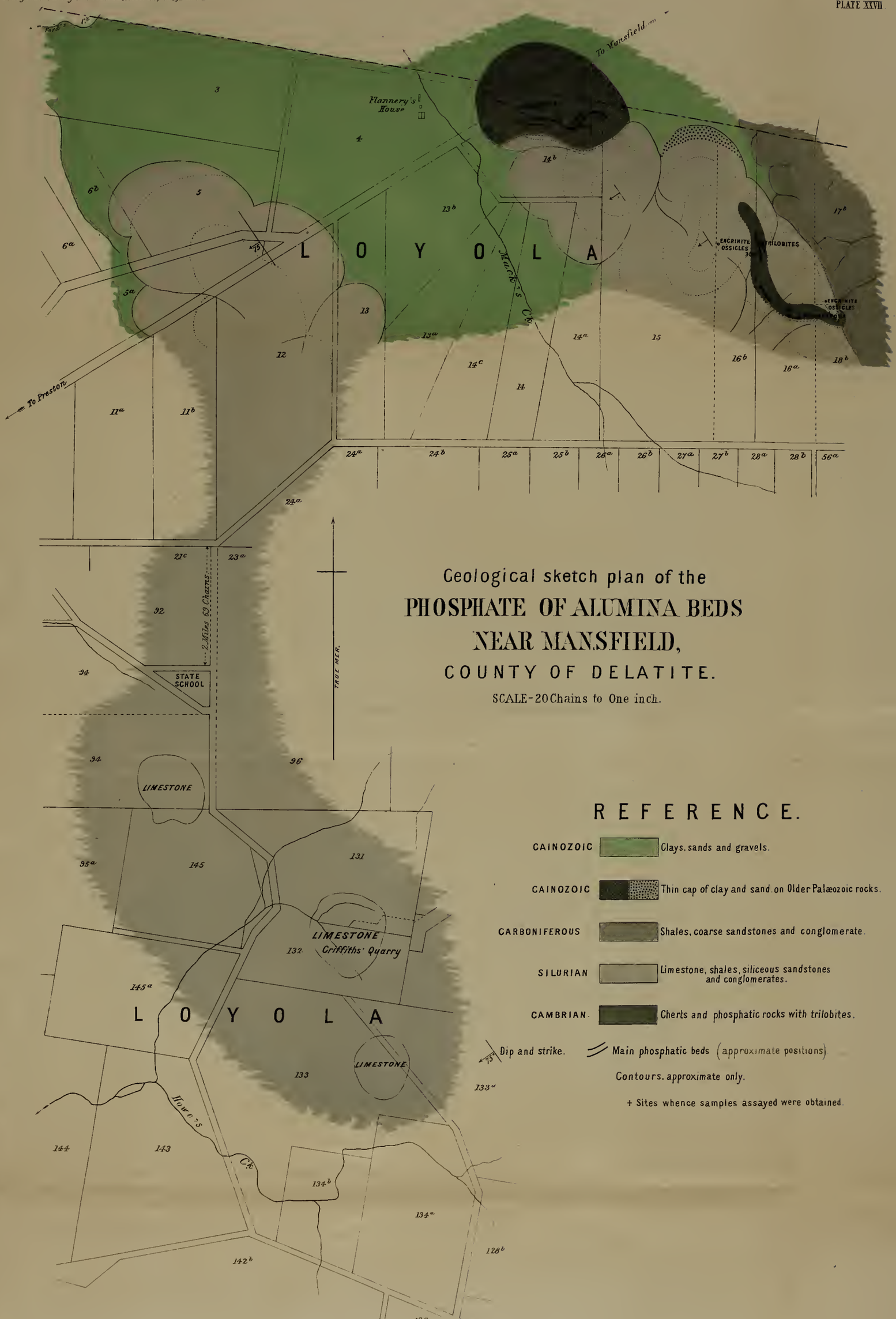
The following lithological and stratigraphical evidence points to the beds being very old:—

1. The rocks are black, grey and green cherts, similar to those of Heathcotian (pre-Ordovician series), and white, grey and black fossiliferous phosphatic rocks.
2. The grey phosphatic rock contains fossil fragments of trilobites and brachiopods, &c., of probably very old forms.
3. The beds show great contortion and tortuous strike.
4. They are unconformable to the overlying Silurian formation, which has a regular strike west of north, while the Cambrian (?) has a very irregular strike, which is nearly east and west in allotment 14B.
5. The Silurian conglomerates contain occasional pebbles and fragments of the cherts, showing that at least the phosphatic and chert beds are older than Silurian.

Analyses of specimens from allotment 14B, parish of Loyola, as made by Mr. P. G. W. Bayly, at the Mines Department Laboratory—

	Picked Samples, No. 17, of Wavellite-bearing rock.	Average Sample, No 18, of Wavellite-bearing rock.
	Percentage.	Percentage.
Insoluble matter	41·86* ...	43·47†
Phosphoric anhydride (P_2O_5) ...	17·36 ...	17·38‡
Alumina (Al_2O_3)	20·84 ...	21·00
Iron peroxide (Fe_2O_3)	3·42 ...	3·14
Water at 100° C.	2·02 ...	1.71
Water (ignition)	14·56 ...	12·31
	100·06	99·01

* Contains silica (SiO_2), 39·64 per cent. † Contains silica (SiO_2), 40·79 per cent.
‡ Gives orthophosphoric acid (H_3PO_4), 23·5 per cent.



Geological sketch plan of the PHOSPHATE OF ALUMINA BEDS NEAR MANSFIELD, COUNTY OF DELATITE.

SCALE - 20 Chains to One inch.

REFERENCE.

CAINOZOIC	Clays, sands and gravels.
CAINOZOIC	Thin cap of clay and sand on Older Palæozoic rocks.
CARBONIFEROUS	Shales, coarse sandstones and conglomerate.
SILURIAN	Limestone, shales, siliceous sandstones and conglomerates.
CAMBRIAN	Cherts and phosphatic rocks with trilobites.

75 Dip and strike. — Main phosphatic beds (approximate positions)

Contours, approximate only.

\+ Sites whence samples assayed were obtained.

Analyses of specimens from allotments Nos. 14B, 16A and 16B, parish of Loyola, as marked on plan—

	Percentage Composition—				
	No. 308.	No. 309.	No. 313.	No. 314.	No. 306.
Insoluble matter	55·43	39·85	66·6	47·27	48·3
Phosphoric anhydride (P_2O_5) ...	15·12	19·93	10·90	15·30	16·3
Alumina (Al_2O_3) and iron peroxide (Fe_2O_3)	11·94	22·61	11·68	22·70	26·7
(Fe_2O_3)	(4·64)	(3·14)	...	...	...
Lime (CaO)	5·12	1·16	1·3	Nil	...
Magnesia (MgO)	Nil	Nil	Trace	0·97	...
Water (H_2O) at 100° C.) Water (ignition) ...)	Not ascertained.				
Orthophosphoric acid (H_3PO_4) calculated from P_2O_5 ...	20·89	27·53	15·05	21·09	22·0

Economic Aspect.

I have traced several of the phosphatic beds, as shown on the sketch plan, but the work was rendered somewhat difficult as surface soil covers most of the hill, and few outcrops, except of cherts, can be seen. However, by trenching across the strata more phosphatic beds may be exposed. In allotment 14B, parish of Loyola, the various phosphatic beds extend for about 20 chains, 6 chains, 10 chains and 10 chains in length, and average about 1 foot in thickness. Approximately, I find that 30 cubic feet are equivalent to one ton, so by rough calculation there would be probably 10,000 tons to a depth, say, of 100 feet, if the beds continue downwards, as the geological evidence indicates.

In allotments 16A and 16B, the beds are smaller, and as I have at present traced them, they extend for lengths of about 10 chains, 10 chains, and 5 chains, with a thickness of 1 foot in parts, but on the average only 6 inches to 7 inches. Here we may say an additional 3,000 tons could be mined to a depth of 100 feet. These beds are about 300 feet higher in altitude than those in allotment 14B. They are $2\frac{1}{2}$ miles from the Mansfield railway station, and the facilities for mining and transport are excellent.

[*Report sent in 6th September*, 1904.]

BRIEF REPORT ON THE MINING FEATURES OF THE HODDLE'S CREEK DISTRICT, WITH PLAN (PLATE XXVIII.).

By O. A. L. Whitelaw.

The following report is made on a preliminary inspection of the mining features of the Hoddle's Creek district:—

Hoddle's Creek is a southerly affluent of the Yarra River, joining that stream near Launching Place Railway Station, which is 41 miles E. of Melbourne. This stream and most of its branches have been worked for alluvial gold since the early days of mining in Victoria. The lead of gold has apparently extended from the Yarra River to the sources of the various tributary streams, and been of fair value. Councillor H. Ewart, who accompanied me during my examination, informed me that he has been connected with, or personally worked, several portions of the lead, and that some of the claims were very good. Certainly a considerable area of ground has been turned over, which may, however, be partly due to the fact of its proximity to the metropolis.

An interesting feature of the formation of the lead is that, while the sinking in the lower portions is from 10 to 20 feet in depth, it increases towards the higher reaches to 60 and 70 feet. I observed that, near the source of the "Dry" lead, which branches from Hoddle's Creek about $2\frac{1}{2}$ miles above Launching Place, the wash is heavy, and waterworn to such an extent as to lead to the inference that it has probably been derived from some previously existing lead. It may have been derived from the sub-basaltic washes, remaining patches of which may be observed on a range some 2 miles further south.

Massey's Reef.

Near the junction of the "Dry" lead with Hoddle's Creek (here called the "Wet" lead) a quartz reef has been recently discovered by Messrs. Massey and party. This is surrounded by alluvial workings. Its outcrop cannot be observed, as a small crushing has been taken out from the surface downwards, and the excavation has been filled up. This crushing, which consisted of a few tons only, gave a return of 30 dwts. per ton, so I was informed. A shaft has now been sunk to a depth of 80 feet, but the reef has not yet been intersected. The strike of this line of reef is said to be nearly due east and west, its dip to the south, and its width up to 12 inches. Later information from Mr. W. Langford is that the reef, about 10 inches wide, carrying gold assaying 4 ozs. to the ton, has been found.

Pioneer Reef.

Five chains further south is the Pioneer reef, which has been worked by a Melbourne company to a depth of about 200 feet. It is now either abandoned or under suspension, and the workings are full of water. The reef is said to be small, and to have a considerable amount of antimony ore associated with it. It has a north and south course, and would junction with Massey's reef, should both these reefs continue. The rock raised from both these mines consists of a grey decomposed sandstone, apparently of Silurian age.

Trinity, United and South United Mines.

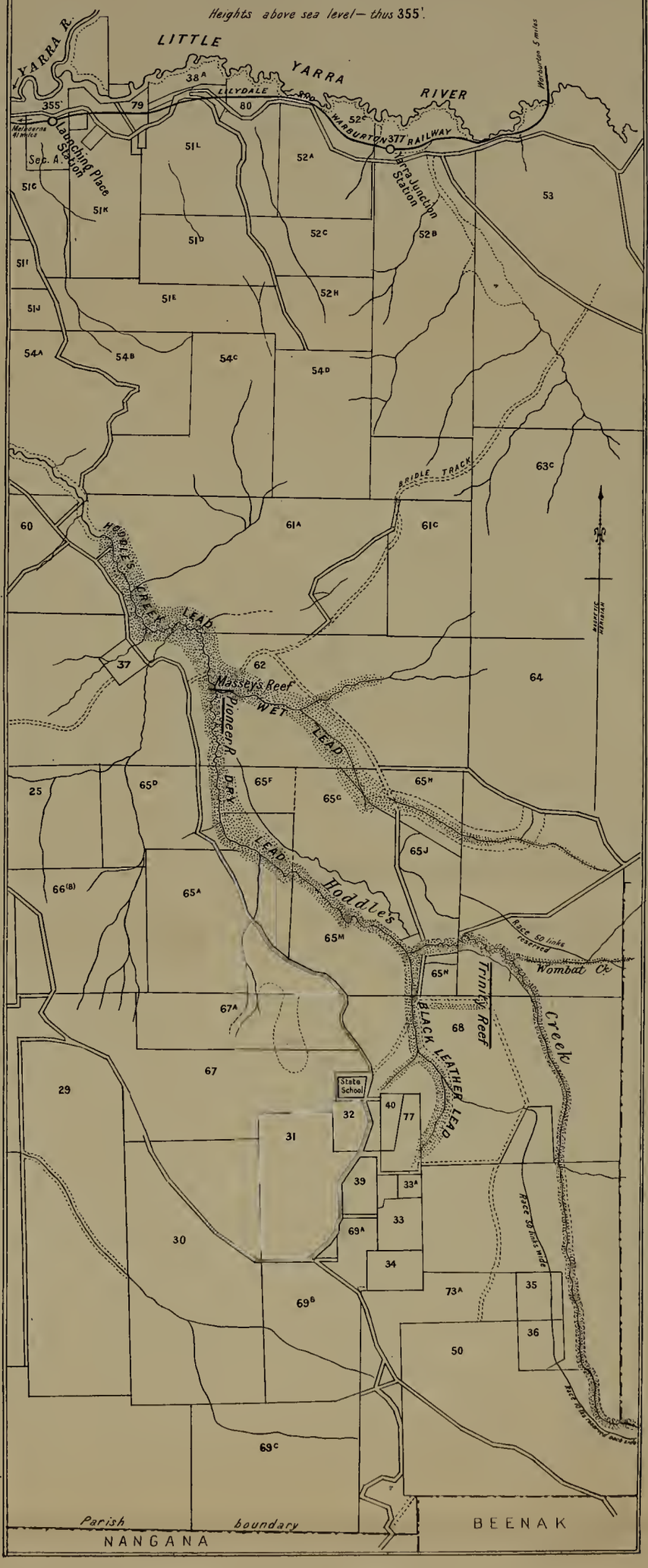
One mile further south, and about $\frac{3}{4}$ mile east of the line of the Pioneer reef, are the three mines known as the Trinity, United and South United, all situated upon the same line of reef. The reef in the United and South United ground has been worked by surface cuts and shallow shafts, the deepest of which is, I understand, about 100 feet. The workings were not available for inspection. Mr. Ewart informed me that the reef averaged about 6 inches, and that upwards of 2,000 ozs. of gold had been obtained. In the Trinity lease an adit has been driven along this reef for a distance of about 300 feet. Near the mouth of the adit a highly decomposed dyke of the diorite type has been cut. I could not observe this in actual association with the quartz reef, but it is likely that such is the case, and it may have influenced the deposition of the gold in the reef. The adit workings are connected with a shaft from the surface. From the upper portion of this shaft ore returning $2\frac{1}{2}$ ozs. per ton is said to have been obtained, but the place is not open for inspection. From the adit level no work has been done. The "reef" averages about 2 inches in thickness, and, according to Mr. W. Langford, has varied up to 18 inches. It has a N. and S. strike and dips to W. at 75 deg.

There are surface indications of the existence of other quartz formations, but none has been opened up. Heavy loam caps the rock formation, which, as seen from the material raised from the workings, consists of arenaceous slate and sandstone.

Plan of portion of PARISH OF WOORI-YALLOCK showing approximate positions of Reefs and Leads in the Hoddle's Creek district.

Scale–40 Chains to an Inch.

Heights above sea level— thus 355'.



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NATURAL HISTORY

Golding's Reef.

About half a-mile east from the last-mentioned workings is the line of reef known as "Golding's." This reef was reported upon by Mr. A. M. Howitt on 26th June, 1899, in connexion with an application for assistance under the Mines Development Act. In his report he states that the reef averages about 10 inches in thickness, with an occasional bulge to 2 feet. Some small crushings returning 1 oz. per ton seem to have been obtained, but nothing of any importance has at any time been found.

For the purpose of testing this reef at a depth, Golding and party were allotted £200 under the Mines Development Act, but, I understand, no improvement upon the conditions experienced in the upper workings was found at a depth.

In addition to the reefs mentioned, I saw several outcrops of reefs, all of which were small, ill-defined "stringers" or quartz leaders.

In conclusion, I beg to state that nothing that was brought under my notice by Mr. Ewart could be considered of any great value from a mining point of view. The quartz formations are merely detached, ill-defined small strings of quartz, and the gold, when present, must have been in small bunches or shoots. It is possible that the quartz formations which lie in decomposed country near the surface, may become less disturbed below water-level, but I see no reason to anticipate any enrichment in their gold supply.

The country seems to me to be worthy of a detailed geological survey, during which it is possible much valuable information regarding the formation and gold supply may be obtained.

[*Report sent in 26th July*, 1904.]

REPORT ON GLACIAL CONGLOMERATE OF SUPPOSED JURASSIC AGE IN PARISH OF WONGA WONGA, NEAR FOSTER, SOUTHERN GIPPSLAND, WITH PLAN (PLATE XXIX.).

By W. H. Ferguson.

The glacial conglomerate near Foster was first noticed on 14th August, 1902, on the Toora-Foster road at Chitt Creek, about four miles from Foster, a railway station on the South-Eastern line, 107¼ miles east of Melbourne. Between Foster and Toora the country, of Silurian and Jurassic strata, drops off steeply to the Cainozoic flats, consisting of alluvium, bayonet grass plains, and low heathy land. This steep slope extends eastwards beyond Welshpool, and has been attributed to faulting. This fault probably lowered the land on the south, so that the waters of Corner Inlet in places reached the foot of the escarpment. From Chitt Creek westward as far as Deep Creek, a distance of 2 miles, the conglomerate has been noted in allotments Nos. 6, 6A, 7 and 9, parish of Wonga Wonga. Glaciated stones were first noted in a small road cutting on the main road on the eastern side of Chitt Creek. These have apparently been derived from higher up the hillside. Metamorphosed Silurian rocks outcrop on the lower part of the hill slope above this small cutting. They are altered shales and sandstones; some are highly micaceous and slightly schistose; others are hard contact quartzites, which resemble the contact rocks of the Strathbogie granite area in the North-Eastern district, though the alteration is not so extreme as that of the rock at the Longwood railway

station; while a small outcrop of impure limestone was also noted. At the top of the Silurian rocks, there is a space occupied by loose angular, sub-angular and waterworn boulders, and pebbles of the underlying rock. This is succeeded by a thin band of conglomerate, which nowhere appears to be more than a few feet in thickness. At the surface this band is decomposed, and it is not possible to state what the matrix of the rounded stones is like. The band includes polished, striated and facetted stones; also many stones which do not show either polish or striation.

Pebbles were noted, from $\frac{1}{2}$ inch up to 18 inches in diameter, of indurated sandstones and grits, quartzites, dense hard fine-grained contact rocks, quartz of various colours, lydianite or black chert, jaspers of various colours, white to grey felsites, indurated mudstones, siliceous shale and a small boulder of granite of moderate grain, not unlike the granite of Yanakie, near Wilson's Promontory.

The appearance of the included stones in the conglomerate suggests that they have been derived from a contact zone between intrusive granite and Silurian or Ordovician sedimentary strata. The exact thickness of the bed was not ascertained. On strike, it varies, and is nowhere more than a very few feet thick. Jurassic rocks occur on the hillside above the conglomerate, the nearest bed being a sandstone of moderate grain. Some of the rocks may be seen to more advantage in the bed of Chitt Creek. The banks of this creek are steep, and there is a small waterfall, where the Jurassic rocks are well exposed, but, unfortunately, neither the glacial bed nor the Silurian rock shows in the creek. At the waterfall there are massive sandstones, normal in grain, a noticeable feature for those near the base of the series. As the stream is followed downwards the beds become coarser, the lowest noted before the alluvium is reached being coarse sandstones and sandy grits, containing quartz pebbles up to $\frac{1}{2}$ inch in diameter. Another band is a sandstone which contains numerous angular and rounded fragments of mudstone and shale. This is a conglomerate of local origin, possibly produced by contemporaneous erosion, or by the action of ground ice of Jurassic age breaking up a previously formed bed of Jurassic mudstone or shale, and transporting the material a short distance from where it formerly occurred. Such beds of conglomerate and breccia occur freely in the coastal sections from Kilcunda to Inverloch, and transport by local ground ice appears to offer the best explanation of their formation. This was inferred regarding these coastal sections before it was known that there was sufficient evidence to establish the occurrence of glacial conglomerate in Gippsland. Between Kilcunda and San Remo two boulders of granite, 3 feet in diameter, occur in sandstone, which is in places somewhat conglomeratic. Their occurrence is difficult to account for without considering the transporting power of ice. These bands of local breccia and conglomerate appear to be basal in character. They occur very freely along the coastal sections, and more rarely in the beds higher in the Jurassic formations, but appear to be rare away from the lower beds of the series.

At Chitt Creek the glacial conglomerate does not outcrop in the bed of the stream. It appears probable that along its strike a change takes place, and that in extension it is represented by the bands of coarse sand, grit, breccia and conglomerate there noted. On allotment No. 11, parish of Wonga Wonga, which is further west than the limit of the glacial band, fragments of grit were seen; these are apparently on the same horizon as the glacial bed. Three miles west of the western limit of the glacial bed, the Jurassic basal beds, within a few feet of the Silurian rocks, become gritty, and are here apparently conformable to the overlying sandstones. These westerly occurrences tend to strengthen the opinion that the glacial

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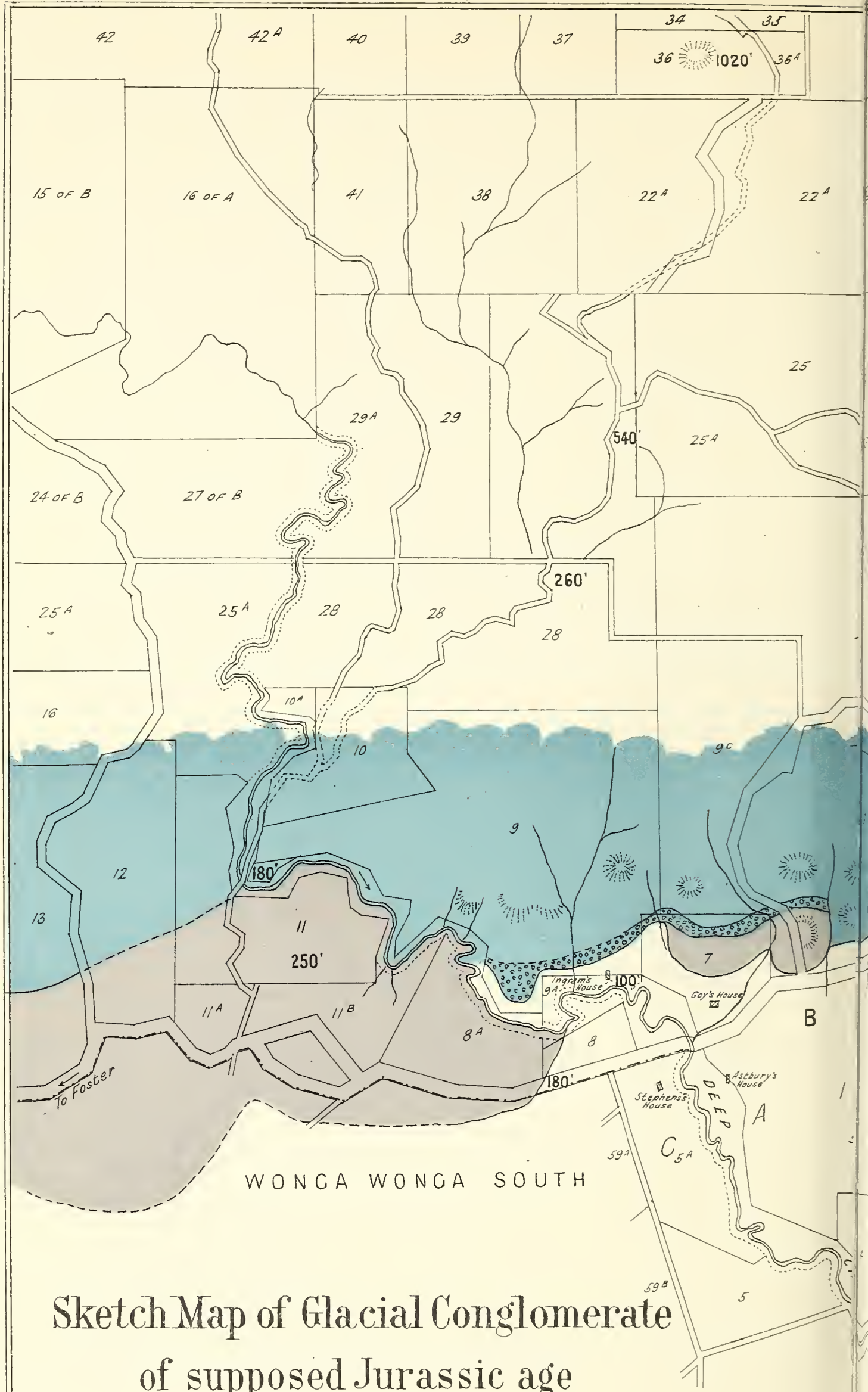

Sketch Map of Glacial Conglomerate of supposed Jurassic age in parish of Wonga Wonga near Foster, Southern Gippsland.

INDEX:— SILURIAN. Shales, sandstones, etc. JURASSIC? Glacial conglomerate.
JURASSIC. Sandstones, mudstones, shales, etc.

To Melbo

T O O R A

FRANKLIN RIVER

31

22

21

20

-B

26A

26B

19

18

17

6A

2A

1

2

3

To Toora

To Toora

MAG. MER.

Very small patch of impure limestone here.

Cutting, showing pebbles in bank, derived from the glacial band higher up the hill side.

Old Saw Mill

CHITT CREEK

N O Z O I C

clayey sands.

FRANKLIN RIVER

T O O R A

TOWNSHIP OF FRANKLIN

FRANKLIN RIVER

STATION 31

SOUTH EASTERN RAILWAY

To Port Albert, 25 3/4 m

Scale — 40 chains to 1 inch.

Aneroid heights in feet above sea level thus – 250'

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bed is conformable to the overlying Jurassic rocks, and along their strike they may pass into a bed of coarse sand and grit, or of local conglomerate or breccia.

The occurrence of glacial conglomerate at Chitt Creek is the first undoubted instance where this rock, associated with rocks which contain the common Victorian Jurassic flora, has been noted by me. Between Glenrowan and Hansen, in the North-Eastern district, fossiliferous rocks of doubtful age occur. These are associated with glacial conglomerate, but the fossils noted were too fragmentary for identification, though probably better specimens might be obtained.

It becomes necessary to consider the age of this deposit at Chitt Creek, as compared with similar occurrences at Bacchus Marsh, and other places, in Victoria, as well as in other countries. The rock in question lies at the base of the Jurassic series of Gippsland. The glacial conglomerate of Bacchus Marsh is considered to be of Permo-Carboniferous or Upper Carboniferous age. The glacial beds of Wynyard in Tasmania, of New South Wales, South Africa and India, are generally referred to the Permo-Carboniferous period. It is a question for consideration whether the Chitt Creek glacial bed is of the same age as the glacial beds of Bacchus Marsh, and those of the other countries mentioned; or that two periods of glacial action have existed in Victoria; or, again, if the lowest beds of the Gippsland carbonaceous area are older than Jurassic and younger than Permo-Carboniferous.

[*Report sent in 28th August*, 1903.]

REPORT ON THE DIATOMITE DEPOSITS AND GENERAL GEOLOGY OF THE PORTLAND DISTRICT, WITH PLAN (PLATE XXX.).

By A. E. Kitson, F.G.S.

Diatomite Deposits.

The diatomite (diatomaceous earth) deposits described herein occur in two localities, one in the parish of Bolwarra, the other in the parish of Gorae.

The Bolwarra Deposit.

This deposit is on the boundary line between allotment C, section XII. (now part of 12), and C1, section III., parish of Bolwarra, between the railway to Portland and the main Heywood to Portland road, about 7 miles from the latter town, as shown on the accompanying map—Plate XXX.

As far as can be judged by a rapid examination of the locality, the deposit is very limited in extent. Bell's Creek runs through the latter allotment a few chains from the deposit, but wherever any evidence of the underlying rock was obtainable along it this was found to be decomposed basalt, not diatomaceous earth. As observed, the deposit is simply a mass of unknown thickness, contained within an area of about half an acre, and occurs on an almost flat extent of country of volcanic origin. It is roughly circular in shape with diameter of about two chains. An old shaft has been sunk, apparently near its northern margin; this now contains water to within 5 feet of the surface. The present depth, tested with a pole, is about 12 feet, but it is said to have been sunk to about 14 feet. Judging by the material on the surface, the deposit has not been pierced here, and

its thickness is therefore doubtful. From the surface down to 3 feet the diatomite is in a partially decomposed and impure condition. It is highly jointed, and infiltrating water, bearing ordinary humus acids from the decomposing vegetation, has so acted upon it that its value is much decreased. The remaining 2 feet visible comprises diatomite of purer quality, though this also is much jointed and stained with oxide or iron in the joints. Doubtless lower down the material is much better, but nothing definite can be said about its quality as a whole until it has been prospected by bores and shafts. Decomposed basalt evidently occurs all around it, for though neither this nor the diatomite is visible at the surface, owing to the covering of soil, still among the roots and mounds of fallen trees the decomposed basalt may be seen, and the margin of the diatomite was approximately defined by testing with a spade. There is no surface indication to distinguish the diatomite from the decomposed basalt, and the deposit was discovered only when sinking post-holes for the boundary fence crossing it. It undoubtedly, at this spot, is not covered with anything but surface soil, composed of a mixture of decayed vegetation and diatomite. This fact shows at once that, in the absence of an overlying impervious stratum, all water falling on the surface soaks rapidly down through the porous material, conveying humus acids which continuously act upon it, and decompose it, while roots of trees disintegrate it to such an extent that all the upper portion is practically valueless. Its occurrence on an almost level plain surrounded by decomposed basalt, and its limited extent, suggest that it was formed either in a rock-hole or depression on the surface of a lava flow which, on the solidification of the lava into basalt, had an impervious floor in which water permanently lodged, or in a depression containing a hot spring, thus admitting of the continued growth and decay of the low forms of vegetable life possessing siliceous structure from which the material has been derived. Similar rock-holes, with and without water, are now visible among the "Stony Rises" at Pirron Yallock, near Colac, while others, varying from a few feet to 50 feet in depth, and a few yards to scores of yards in breadth, occur in various parts of the Portland district, and also in many other volcanic districts in Victoria. If this view is correct, numerous other similar deposits probably occur distributed over the volcanic plains of the district. Their size and value will, of course, depend upon the size of the original hollows, whether as rock-holes, lakelets or dams; the permanence of the conditions respecting the growth of the necessary forms of vegetation; and the presence or absence of a protective covering.

About 6 chains to the N.W. of this deposit, I found two small pieces of what looks like decomposing diatomite among the roots of an uprooted tree. This is apparently separated by decomposed basalt from the deposit described, as far as can be ascertained by testing the intervening area with a spade, and the mounds of uprooted trees. If, therefore, it is diatomite it probably indicates a similar occurrence, but of unknown size. This material is now being further tested.

Assuming the deposit to be the shape of a truncated inverted cone, with a basal diameter of 120 feet, and a smaller diameter of about 100 feet, and taking it to be 15 feet thick, the lower portion (10 feet) to be diatomite of value, and the dry weight, that given to me by Mr. Ewen Cameron, M.P., viz., 25 lbs. per cubic foot, it contains about 900 tons of diatomite of value. This, at £1 per ton, said to be the local price of the material, would indicate a sufficient inducement to thoroughly prospect it by boring or shaft sinking, preferably the former, on the score of despatch and economy. A small, light hand-boring plant, capable of boring to 25 or 30 feet, would answer the purpose of proving the deposit. It should first be tried with the ordinary twist auger, like a wood auger, which would extract a core sufficiently good to show

the nature of the material, if that were coherent enough, as in a wet state it probably would be. Should this not answer the purpose, then a shell auger could be used. This, though very much slower in work, brings up a much better and compact core. Judging by experience in boring through stiff sandy clays on the Powlett Plains, Southern Gippsland, I should say that if the boring does not exceed 15 feet in depth, one man with a twist auger could easily bore 50 feet a day through this material, and about 30 feet if the shell auger be used. If the boring be deeper than 15 feet, it is advisable to have two men (even though there would not be a corresponding increase in despatch) to get the rods out of the hole, so as to ease them down, and prevent bending of rods and stripping of threads. Samples of the cores at 1 foot intervals (or less, if necessary) should be carefully obtained for examination.

Should the deposit be opened up, the material could easily be carted to Portland wharf for transport by water, or, if preferred, to the railway, a few chains to the westward of the occurrence, where a small siding could be cheaply erected.

The following analyses of the diatomite have been made at the Mines Department Laboratory. Analysis A, made in 1901, indicates diatomite of good quality, but in the absence of knowledge as to what part of the deposit the sample was taken from, no conclusion can be formed as to whether or not it was a representative one. Analyses B and C, made by Mr. P. G. W. Bayly, of samples collected by me round the shaft, indicate diatomite of poorer quality :—

—	Sample A.	Sample B.	Sample C.
	%	%	%
Silica (SiO_2)	85·98	71·23	70·52
Alumina (Al_2O_3) ...	3·05	7·33	10·77
Ferric Oxide (Fe_2O_3)		2·70	3·26
Lime (CaO)	nil	trace	·75
Magnesia (MgO) ...	trace	nil	nil
Soda (Na_2O)	...	nil	·41
Potash (K_2O)	...	nil	·09
Chlorine (Cl) ..	...	·51	·54
Water (H_2O) at 100° C. ...	6·81	13·98	8·82
Water combined	3·35	4·67	5·08
	99·19	100·42	100·24

The Gorae Deposit.

The occurrence in the parish of Gorae was said to occur along Boomer's Creek, about $2\frac{1}{2}$ miles N.W. of that of Bolwarra. On proceeding thither the same day, in company with Cr. E. Adams and two local residents, who said they knew where it was, we made an extended examination of the locality, but failed to find it. Neither did success attend the efforts of Mr. Hollis, a neighbouring selector, who said that some years ago he had seen there a small outcrop like an anthill. Since my visit, Mr. Adams, who finally succeeded in locating it after three different attempts, informs me that it does not seem to be an extensive deposit, but that testing the ground all round is necessary to prove its extent.

The following is the analysis of a sample from this deposit, made at the Mines Department Laboratory by Mr. L. G. Benjamin:—

No. 602.	%
Silica (SiO_2)	74·34
Alumina (Al_2O_3)	8·36
Ferric oxide (Fe_2O_3)	2·66
Lime (CaO)	—
Magnesia (MgO)	—
Soda (Na_2O)	·09
Potash (K_2O)	·02
Water (H_2) at 100° C.	9 12
Water combined	4·91
	99·50

This indicates diatomite of better quality than that of samples B and C from the Bolwarra deposit.

Diatomaceous earth is used for various purposes—as an absorbent for nitro-glycerine in the manufacture of dynamite, when it must be in a pure state; for packing for boilers and steam pipes, owing to its non-conduction of heat; as polishing powder; as light fire-bricks, because of its lightness and infusibility; in the manufacture of water-glass and soap, on account of its solubility in alkalies. In view of its value and the increased attention that is being paid to it in Victoria, I should strongly advise local people to make a careful examination of the volcanic portion of the district, when I have no doubt other deposits will be found. In prospecting for it here, special care should be taken to examine all water-channels, every fragment of coherent earthy material seen, and all mounds of uprooted trees. If these mounds show anything definite, then with a spade the hollows in which the trees stood should be tested. This will be a much quicker and less laborious method than digging at random over a large extent of country.

Diatoms are of common occurrence in some of the younger geological formations, such as those of Upper Cainozoic to Recent age. Most of them are aquatic in habit, and live in fresh, brackish or salt water, either of high temperatures as in the hot springs of volcanic districts, or of low ones as the very cold water of glacial lakes. There are between 1,000 and 2,000 known species, and by virtue of their remarkably rapid development they form, under suitable conditions, and in a short space of time, geologically considered, deposits of considerable thickness, such as that at Richmond, Virginia, U.S.A., which is 40 feet thick, and extends over a considerable area.

General Geology of the Portland District.

A brief description of the general geology of the Portland district is given in the following notes:

The oldest visible formations are friable white and yellowish limestones, that show from 10 to 35 feet thick in coastal cliff sections in the town of Portland, from the railway station along the shore of Portland Bay for about two miles to the north. These contain a few fossils, principally echinoids (sea urchins), brachiopods (lamp shells) and whalebone, which show the deposit to be of early Cainozoic age, probably Oligocene or Eocene. This deposit is of great thickness and extent; it underlies all South-Western Victoria. In Portland, it has been proved to have a thickness of at least

The topographical information on this map has been obtained from Crown Lands plans by Henry Wade in 1851 and 1853.
Light sandy soil covered with heath and scrub, probably occurring as a cap on decomposed basalt.
Buckshot gravels
Heath
BORE N°2. Total depth 510 ft. The strata comprise 7 feet of sandy soil and yellow clay, and 503 feet of limestone and clay, with Oligocene or Eocene shells
SURRY
MAG. MER.
RIVER
BOUNDARY OF SPRINGY BARK
NEWBOLD ROAD TO PORTLAND
TEA TREE
Approximate position of Gorae diatomite deposit.
"Permanent water RESERVE"
Site of Major Mitchell's last camp before reaching the coast on his exploring expedition from Sydney in 1836 (E. Adams)
GORAE
RESERVE
OLD PORTLAND ROAD
ROUGH ROCKY
VERY BOGGY
DENSE GUM SCRUB AND HEATH
THICK SPINIFEX BARK
TEA TREE VERY BOGGY
RAILWAY
Volcanic
BOUNDARY
HAMILTON
BOLWARRA
BELL'S CREEK
Permanent (Fresh) Water Hole
CAMPING GROUND
BECK'S BRIDGE
PARISH
Decomposed basalt occurs all round
Drift, with diatomite deposits
Approximate position of Bolwarra diatomite deposit.
SIDING
CHERRY TREE
TEA TREE SCRUB VERY BOGGY
PORTLAND
Permanent
Volcanic ash.
Red soil
Recent deposits of blown sand and drift
Raised beach.
ROAD TO PORT FAIRY
Breakers
QUARRY AND WATER
Permanent (Fresh)
STEEP CLIFF OLD COAST LINE
Volcanic basalt
Decomposed basalt
Small dunes.
PORTLAND BAY
SITE OF HENTY'S OLD WHALE OIL ESTABLISHMENT.
PARISH BOUNDARY
LANGSTER'S OLD STATION
STONE
PUBLIC RES.
STOCKADE
PORTLAND
A thin cap of sandy soil overlies basalt? on this area
Volcanic basalt from the Nullo outflow area
LIGHT HOUSE
Whaler's Pt.
High cliff, composed of about 30 ft. of decomposed basalt, on several feet of yellow calcareous clays, with numerous water shells (at places) on white friable limestone (Oligocene or Eocene), 35 ft.
White friable limestone, with patches of compact limestone & oval flattened & rounded coral patches and regions of greenish, brownish and dark rose sandy clay, form the lower portion of the cliffs from Whaler's point to point A. The limestone contains here & there fragments of brachiopods, gasteropods, echini, etc., and is of Oligocene or Eocene age. Decomposed basalt overlies it. The volcanic material was spread over an eroded surface of the limestone.
Decomposed basalt fills an old channel in the limestone here.
Decomposed basalt.
BATHING HOUSE
OLD RAILWAY STATION
JETTY
BOTANIC GARDENS
BORE N°1
Total depth, 2265 feet 5 inches. The strata comprise about 46 feet 9 inches of sands and clays with Recent shells, and 2218 feet 9 inches of limestones and clays, with Oligocene or Eocene shells
WAYTLE HILL
CREEK

Sketch Geological Map of Portion of the Portland District, showing Sites of DIATOMITE DEPOSITS.

Scale — 80 chains to 1 inch.

WISCONSIN
STATE HISTORICAL SOCIETY

2,218 ft. 9 in., for a bore, sunk in the Botanical Gardens reserve to a depth of 2,265 ft. 6 in., had not pierced it when boring was discontinued. The upper portion, 46 ft. 9 in., of this bore proved sands and clays with Recent shells.

Overlying these limestones at Whaler's Bluff, on Portland Bay, is a bed, about 12 feet thick, of oyster shells and clay, the shells occurring in such numbers as to form a mass consisting almost entirely of shells. This oyster bed is regarded by Mr. J. Dennant, F.G.S., F.C.S., in his paper *Notes on Post-Tertiary Strata in South-Western Victoria*, published in the *Transactions of the Royal Society of Victoria*, Vol. XXIII., 1886, as of Miocene age. It is not now visible in the cliff to the south of Whaler's Bluff, but probably once occurred there, and has been entirely removed by denudation before the overlying rocks were formed. These rocks consist of basalt in a decomposed state, which caps Whaler's Bluff, extending to the south, west and north of this place. They have a thickness at Whaler's Bluff of about 90 feet, but are only about 20 feet thick in the cliff near the public baths. They also furnish additional evidence of the erosion of the Oligocene or Eocene limestones and the Miocene oyster bed, for, in the cliff, in two places, there is evidence of two narrow channels, apparently due to stream action prior to the outpouring of the volcanic rocks. Here the basalt is seen at or near present sea level, with limestone visible on both edges for a good many feet, indicating that the volcanic rock, while in a fluid state, flowed into the old streams.

These volcanics, which are probably of Miocene or Pliocene age, extend back from the coast in a strip several miles wide, bearing in places a thin cap of sand. They consist of decomposed and decomposing spheroidal basalt, which, strange to say, furnishes a poor, brownish-grey, clayey soil, thus affording a strong contrast to the greater number of the basalts of Victoria. Along the main Portland-Heywood road, near the junction of this and the Port Fairy road, there are beds of volcanic ash and mud, in addition to the basalt referred to. These decompose into a dark red soil, but of poor quality.

Basalt also occurs in the cliffs at Cape Grant and outcrops among old sand dunes near Mount Chaucer. Capping this, in places is a thin deposit of blown sand, while swamp deposits occur inland in numbers of places. From Portland to the south coast at Capes Grant and Nelson, and extending westward for many miles to the mouth of the Glenelg River, there is a cap of dune sandstone (consolidated blown sand of old sand dunes), while along the northern margin of Bridgewater Bay and all along that of Discovery Bay, Mr. Dennant shows that shifting sand dunes occur. These consolidated dunes are probably of Pleistocene age, and the shifting ones are younger, viz., Recent.

On the northern and north-western shores of Portland Bay there is an almost flat expanse of low sand dunes and swamps, extending back to cliffs of the volcanic rocks. These cliffs represent the old coast-line; the country between was once part of Portland Bay, and has been naturally reclaimed recently by the action of waves and wind in filling it up with sand.

The vegetation in the volcanic area consists of messmate, peppermint, native cherry, native willow, prickly mimosa and other acacias, heath, &c., which elsewhere in Victoria form the characteristic vegetation of soil of poor quality, while that on the older dunes is chiefly stunted sheoak, tea-tree and heath, with patches of stunted messmate, peppermint, and manna gum. An interesting clump of Eucalypts, the occurrence of which was kindly brought

under my notice by Mr. Adams, occurs at Mount Chaucer. This species of gum has been identified by Mr. J. H. Maiden, Government Botanist of New South Wales, as *Eucalyptus diversifolia*. There is little to break the generally level character of the country, except shallow gullies and low rises in some parts, and the occurrence over the volcanic portion of the whole district of the more or less basin-shaped hollows already mentioned.

One of these, containing permanent water, occurs in the water reserve in allotment A, section X., parish of Bolwarra, on the western side of the Heywood to Portland road. It is of historical interest, since it is the water-hole at which, according to Mr. Adams, Major Mitchell had his last camp before reaching the coast on his exploring expedition from Sydney in 1836.

I wish to tender my best thanks to Councillor Adams, who kindly showed me over the district.

[*Report sent in 29th September*, 1904.]

REPORT ON THE GENERAL GEOLOGICAL FEATURES OF THE WELSHPOOL-HEDLEY DISTRICT, WITH PLAN (PLATE XXXI.).

By A. E. Kitson, F.G.S.

The beds of the Jurassic series, forming the southern portion of the hills to the N. and N.W. of Hedley railway station, show a regular dip towards N.E. of from 23 deg. to 27 deg., as may be seen on the accompanying sketch map—Plate XXXI. In allotment 64, parish of Welshpool, $\frac{3}{4}$ mile west of the last outcrop examined, the beds show a curve towards the N.W.; while further W., the beds in the northern part of the area still dip towards N.W.; in the central part more nearly W., with a sharp twist in two places to S.; and in the southern part show a pronounced general dip towards N., though at one place there is a westerly dip, probably only of local extent.

As many observations for dip were made as was practicable under the circumstances. A large portion of the area is still covered with dense vegetation. During my inspection it rained steadily the whole time. All the creeks were in high flood, and it was only in the smaller gullies, destitute of scrub and rubbish, and in occasional road cuttings, that dips were obtainable. Therefore too much importance should not be attached to deductions respecting the physical character of the strata drawn upon such evidence as has been obtained.

The rocks visible are mainly massive beds of brown and grey argillaceous and felspathic sandstones, with occasional beds of brown sandy shales, and olive and yellow mudstones. Doubtless, many others of the last-mentioned rocks also occur, but as they weather away very rapidly, and become thickly covered with vegetation, they are usually invisible, unless exposed by recent sections. In several places the occurrence of fragments of carbonaceous matter among the sandstones and thin intercalated beds, and laminæ of the same, have been noted.

Mr. J. Gregory informed me that a "seam of black coal, 6 inches thick," occurs in his allotment, No. 20. parish of Welshpool, in the bed of Nine

Sketch Map
Showing the General Geological Features of the WELSHPOOL-HEDLEY DISTRICT.

Scale — 40 chains to 1 inch.

INDEX:— Jurassic. *Felspathic sandstones, mudstones, etc.* Eocene? *Grits, gravels, sands, clays, etc.* Post Pliocene. *Alluvium, etc.*

Heights in feet above sea level - Railway, 42'; Aneroid, 470'.

Mile Creek. A sample of this he has had analyzed in the Mines Department Laboratory. The analysis has been officially supplied to me, and is as follows:—

	%
Moisture	6.11
Volatile hydro-carbons	19.75
Fixed carbon	29.52
Ash	44.62
	100.00

This analysis indicates a very impure coal. I was not enabled to see the alleged "seam" owing to the flooded state of the creek, so can say nothing definite about it.

The strata generally in the district, as far as observed, do not show such frequent alternations of mudstones with sandstones and shales as do those of the coalfields area about Korumburra, Jumbunna and Outtrim; nor are they of such promising appearance as those visible in the railway cuttings near Foster. Nevertheless, there seems to me to be a prospect of coal seams, though probably not of payable thickness, being in the district, and I should like to see the area behind Welshpool given a trial by boring before the drill, now at Hedley, be removed from the district.

The site of a bore best suited to test the locality is, in my opinion, somewhere in allotments 18 or 1, section A, parish of Welshpool, but it is impracticable at present to get a drill conveyed thither at a reasonable cost on account of the uncleared character of the country, and the absence of a road.

The general geology of the district has been reported upon by me previously,* but I may add a few observations made during my recent visit.

The Cainozoic sediments previously referred to as occurring on the Hodgkinson-Upper Agnes River road extend across Nine Mile Creek, and occupy the lower portions of the spurs, the boundary line between them and the Jurassic series being here marked by a sharp rise in the spurs. The deposits consist of clays, clayey sands and gravel, chiefly of white, grey, red and yellow colours, together with very hard, dense, fine and coarse siliceous grits of the same colours. They are provisionally classed as of Eocene age. A deposit of pebbly sands, gravels and clays belonging to the same series occurs in the northern part of the parish of Welshpool (allotments 64 and 29 of section A), adjoining the parish of Binginwarri.

The pebbly gravels contain numerous pebbles of quartz, schorlaceous quartz, indurated sandstones and slates, with a little schorl, magnetite, titaniferous iron, small zircons, and, so Mr. J. Crouch informed me, a little fine gold.

They are evidently part of the Agnes River stanniferous series, and occupy a basin low down among the hills of Jurassic rocks. These hills in the ridge just to the S. of the area form the southern watershed of Billy's Creek, a tributary of the Albert River, and have an altitude of between 800 and 900 feet above sea level.

From the additional evidence furnished by these Cainozoic deposits, I am now strongly inclined to the opinion that the strata, showing 3 beds of brown coal aggregating 125 ft. 10 in., occurring under the Hedley plain, as disclosed by the records of the bore, proving 270 feet of Cainozoics on 1,832 ft. 6 in. of Jurassics, and those forming the Agnes River stanniferous series, are portions of the same series, and are remnants of once widespread deposits of fluvio-lacustrine origin, which owe their present position to extensive and great downthrow faults.

[*Report sent in* 12*th July*, 1902.]

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* Report on the Probable Occurrence of Coal in the Welshpool District.—Records Geol. Surv. Vict., Vol. I., Part I., pp. 61–66.

REPORT ON THE DISCOVERY OF AURIFEROUS QUARTZ AT A DEPTH OF 4,156 FEET IN THE NEW CHUM RAILWAY MINE, BENDIGO, WITH PHOTOGRAPH (PLATE XXXII.).

By E. J. Dunn, F.G.S., Director of the Geological Survey.

A development fraught with importance is that at a depth of 4,156 feet in this mine, and 800 feet below the last body of quartz of a payable nature, excellent-looking quartz of great size and in centre-country (the anticline) has been sunk through in the winze. The slate and sandstone are highly mineralized. The quartz also carries sulphides, and, what is more important, gold.

In no part of the mine have the appearances for gold been more favourable than in the bottom of the winze. The quartz resembles a broken saddle reef, and is in centre-country. The winze passed through over 20 feet of quartz, and what appears to be spurry country; while a leg occurs on the W. side. Further work is necessary to definitely settle the nature of the quartz body, and also to prospect it, so as to determine whether or not there is sufficient gold present to be payable. Even at this great depth 7 dwts. of gold per ton is considered worth working. Should this body of quartz prove payably auriferous it adds enormously to the proved resources in gold of this State, and it is certain to exert a powerful influence in the further development of the Bendigo gold-field.

Then as to the possibility of working at such depths, it is to be noted that in the bottom of the winze, 4,156 feet from the surface, the rocks are cool and the water cool, while the supply of air is excellent. The rocks and the water are cooler at the bottom of the winze than at the bottom of the shaft, 3,900 feet deep. There appears to be no reason why the shaft should not be continued to 5,000 feet or more in depth, and the conditions then as regards temperature should be such that mining can be carried on satisfactorily and without undue distress to the miner. With the cheapened methods of producing ice, the air that would be sent below might be cooled and filtered. As this is the deepest body of quartz carrying gold that has yet been opened up in Victoria, the accompanying photograph has been taken of it—see Plate XXXII.

The quartz is highly mineralized, sulphide of iron predominating, and particles of fine gold being visible. The country rock surrounding the quartz is grey sandstone and black slate, through the former of which iron pyrites are abundantly disseminated.

The quartz vein on the right of the photograph conforms to the bedding of the country, and is apparently the W. leg.

[*Report sent in 4th April*, 1905.]

REPORT ON ROCKS FROM BENDIGO.

By D. J. Mahony, B.Sc., late Lecturer and Demonstrator in Geology, Melbourne University.

The specimens consist of 14 rocks, with slices prepared from them for microscopic examination, and were chosen from the collection made by Mr. H. S. Whitelaw, at Bendigo. These rocks were collected from three situations, viz., two from the 296-feet level, New Chum Railway mine; five from depths ranging from 3,860 feet to 4,025 feet in the New

Auriferous Quartz in "Centre Country" at depth of 4,150 feet in the NEW CHUM RAILWAY MINE, BENDIGO.
Scale : 1 foot to 1 inch.

Chum Railway and Victoria Reef mines; and six from the Big Hill railway tunnel, near Ravenswood, at distances of from 1,400 feet to 1,600 feet from the grano-diorite contact.

All these are lower Ordovician sedimentary rocks, and belong to the Bendigo series, founded by Mr. T. S. Hall, M.A., on the Graptolite fauna.*

The primary object of the examination was to determine whether there is any indication of the deep workings of the above mines approaching the underlying granitic rocks.

New Chum Railway Mine.

A. Specimens from the 296-feet level.

One of these is a dark grey, well cleaved slate, with a silky lustre. With the pocket lens some minute flakes of a micaceous mineral can be seen on the cleavage faces. It is very easily scratched with a knife. Under the microscope it is seen to be a typical fine-grained slate, composed for the most part of fine white flakes of a hydrous mica, which may here be called sericite, formed by the alteration of the original constituents.† Parts of the flakes form bands, in which they are parallel to one another, but between these bands the mica lies in all directions. The mica is intimately associated with green chloritic material, which is typical of the slates, and is not found in shales and clays. In addition, there are numerous minute clay-slate needles (rutile) and small black dots and patches, which are probably carbonaceous. There is a distinct cleavage developed. The slide as a whole presents a finely laminated appearance, due to the somewhat deeper colour of some of the bands.

The other specimen from this level is a fine-grained grey sandstone. The quartz grains are large enough to be seen with the naked eye. There are a few cubes of pyrites scattered through the rock, which is fairly hard, but can be scratched with a knife. Microscopically, it is seen to consist for the most part of quartz grains, generally rounded, though some are quite angular. The quartz encloses little zircons, &c., and many fluid cavities, and has all the appearance of having been derived from a granitic rock. Amongst the quartz grains are a few scattered fragments of a plagioclase felspar, which appear quite undecomposed—a remarkable fact, considering the great age of the rock, and that the felspar is one of the original constituents. It is polysynthetically twinned, the twinning being moderately fine. The only section from the 001-100 zone in the slice gave an extinction angle of 15 deg. This agrees with the measurements made by Dr. A. W. Howitt, who examined a large number of these rocks in 1893‡, and indicates andesine. It is particularly interesting, as, being found together with granitic quartz, it suggests the existence of a pre-Ordovician rock similar to our Devonian grano-diorites. The remaining original minerals are a few flakes of muscovite, now much bent and distorted, some grains of zircon, a few broken crystals of brown tourmaline, and some flakes of chlorite that may represent biotite. These minerals are set in a "paste" of sericite and chlorite, with numerous clay-slate needles and secondary quartz. In places there are patches of calcite.

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* T. S. Hall, M.A. The Graptolite-bearing Rocks of Victoria, Australia.—Geol. Mag. Vol. VI., 1899.
† Hutchings, W. M. On the Origin of Some Slates.—Geol. Mag. 1900.
‡ Notes on Samples of Rock collected in the 180 Mine at Bendigo.—Spec. Rept., Dept. of Mines, 1893.

New Chum Railway and Victoria Reef Mines.

B. Specimens from the Deeper Levels (3860 *feet to* 4.025 *feet*).

An examination of one of these slates shows it to be remarkably like that already described. The hand specimen is dark grey in colour, easily scratched with a knife, giving a light grey powder, and distinctly cleaved. None of the minerals can be distinguished with a pocket lens. Some infiltrated calcite can be seen along one of the cleavages. Under the microscope it is seen to consist almost entirely of sericite, with chloritic material, clay-slate needles and carbon, as before.

Another sample is a much crushed rock, in which all trace of the regular parallel cleavages is lost. Cleavage still exists, but the planes are much bent. The colour is dark greenish-grey, the lustre silky, and the grain very fine. In places, small micaceous scales can be observed. The face sliced for the microscope section shows how the variously coloured bands have been crushed and folded together. The microscope shows it to be a very fine-grained sandstone. Many of the quartz grains show a "wavy" extinction, due to pressure. The ground mass is similar to that in the sandstone already described.

A slate from the 3,900-feet level of the New Chum Railway mine is something like the above, but has a rather more silky lustre. Some of the cleavage planes are puckered into minute wrinkles. Through the centre of the slate there was originally a thin band of sandstone. This has been crushed into lenticular pieces, round which the slate has, by the pressure, been forced to flow. The microscope shows that the slate is similar in mineral composition to those already described. The lines along which shearing has taken place are darker than the rest of the slide, and are often thrown into minute wrinkles. They appear to have been formed after the sericite. The quartzite occurs in patches entirely surrounded by slate, and consists of grains of quartz and a few pieces of plagioclase set in the usual paste. Some of the larger quartz grains appear to be of secondary origin. For instance, in one case a well formed crystal of pyrite is surrounded on three sides by the same quartz grain, and in another a group of carbonaceous spots lies partly in the groundmass and partly within a quartz vein. Some of the grains, which appear to consist of a single piece of quartz, are shown by polarized light to be composite.

The remaining specimens are quartzites. They are grey in colour, and moderately fine-grained. The fracture is rather splintery, and leaves a face with a vitreous lustre, due to infiltration of quartz; but the original grains can still be seen. The microscope shows that most of the quartz grains are sub-angular. They contain great numbers of fluid cavities, and sometimes small zircons, also minute prisms of some other mineral, and occasionally hair-like inclusions of extreme thinness, which may be rutile (Hutchings)*. Some of these grains are crushed into a mosaic, or give a "wavy" extinction. Here, again, there is evidence in the relation of the quartz to the pyrites that the quartz-grains are not all primary, and, in addition, a flake of original muscovite is partly enclosed by one of them. There are also some plagioclase fragments present. One gives an extinction of 12 deg. in the 001-100 zone. They are polysynthetically twinned and undecomposed. Some rounded grains of a colourless or yellowish mineral, with an extremely high refractive index, occur occasionally. It may be rutile or anatase. In addition,

* Clays, Shales, and Slates.—Geol. Mag., 1896.

there are a few broken crystals of brown tourmaline, and grains of zircon and brookite. These minerals are set in a paste similar to that already described, but containing more secondary quartz. In places there are patches of calcite.

C. Specimens from near the Grano-Diorite.

These may be divided into altered slates and altered sandstones.

Taking, first, some samples that present a general resemblance to the unaltered slates, they are found to be so hardened that they cannot be scratched with a knife. The cleavage is not so well marked, and the silky lustre has disappeared. The whole rock is full of small, newly formed crystals, with brightly reflecting cleavage faces. The general colour is still dark-grey; but the whole rock is full of little spots rather darker than the other parts. Through the microscope these spots appear more transparent than the rest of the rock. They are colourless, and have a low refractive index. They are elongated in one direction, have quite an irregular outline, and are arranged so that the direction of greatest length is parallel in all. The central part is, as a rule, full of small inclusions, apparently carbonaceous, arranged in lines parallel to the greatest length of the spot. The outer rim is clearer, though it encloses flakes of brown mica, minute pleochroic prisms and carbonaceous spots. There are also rarer inclusions of muscovite. Examined with doubly polarized light, these spots are seen to be doubly refracting, with interference colours not unlike those of quartz. Sometimes they extinguish all over at the same instant, but sometimes they are resolved into a collection of granules. In one case a spot appears to consist of four sectors, forming an interpenetration twin. There are no cleavages, so the extinction angle was measured from the lines of inclusions. It varied from 0 deg. to 43 deg. The line of inclusions may not indicate the trace of one of the axial planes, and in that case the spots agree fairly well with those identified by Hutchings as cordierite*. The next striking mineral present is a colourless pyroxene. One of the prisms is in part coloured light-brown, and this part is strongly pleochroic, brown to almost colourless. The boundaries are well developed crystal faces, the best being (110). The pinacoids are relatively rare. The pyroxene is monoclinic, with a maximum extinction of 35 deg. The interference colours are yellow or grey. It is the largest mineral in the rock. Brown mica has also been largely developed. It is intensely pleochroic, and appears to be a haughtonite. The crystals are most common near the spots, but are scattered all through the rock. As a rule, but by no means always, they are parallel to the length of the spots. Muscovite has been formed in smaller quantities. These minerals are set in a ground mass, consisting of the mineral forming the spots and quartz. It is full of bands and lines of dark inclusions. The quartz appears to be all secondary.

Another altered slate, considerably lighter in colour, has not been hardened in the same way. It is yellowish-grey, and full of greenish spots. These spots are arranged in the same way as before, but consist of small muscovite flakes and small grains of quartz (?). The mica flakes are, as a rule, parallel to one another, so that with a low power objective the spot appears to extinguish all over at the same moment. The spots contain some chlorite, and some larger flakes of muscovite, which do not conform to the general arrangement. These larger flakes occur plentifully

* Geol. Mag., 1894.

throughout the rock. There is a good deal of indefinite chloritic matter in the slide, and some has developed in well formed flakes (ripidolite?). There are some scattered grains of quartz, and, rarer, brookite, probably derived from the clay-slate needles.* Secondary limonite occurs in places.

The altered sandstones are reddish or yellowish-grey in colour, and show indistinct spots at times. They can be scratched with a knife. Plentiful muscovite flakes and small quartz grains can be seen in the hand specimens.

The greater part of these rocks is composed of sand grains, which are sometimes enclosed in the larger muscovite flakes that have been developed by the contact metamorphism. There are small prisms of tourmaline that have evidently been developed *in situ*. Some are quite minute, and enclosed in the quartz, but can be recognised by their strong pleochroism. The finer parts of the rock are made up of small muscovite flakes, with plentiful chloritic material and quartz. There are fairly plentiful grains of brookite.

Table showing the secondary minerals found in the rocks examined from the Bendigo district:—

—	Rocks at 296ft.	Rocks below 3,800ft.	Rocks near Ravenswood. Grano-diorite.
Quartz	*	*	*
Sericite	*	*	...
Muscovite	...	...	*
Tourmaline	...	...	*
Clay-slate needles ...	*	*	...
Chlorite	*	*	*
Brookite	...	* (rare)	*
Haughtonite	...	...	*
Pyroxene	...	...	*
Cordierite (?)	...	...	*

* Indicates occurrence of mineral.

As a result of this examination, there can scarcely be any doubt that the rocks at 4.000 feet, in the Victoria Reef and New Chum Railway mines, are not within the zone of alteration produced by the grano-diorite. The only mineral that suggests the slightest change due to thermo-metamorphism is the brookite, which occurs sparingly in one of the sandstones, and may have been produced by the heat from some neighbouring dyke. The rocks at 1,600 feet from the grano-diorite have been shown to be considerably altered, so it may be concluded that the deepest parts of the mines are at least 2,000 feet from the grano-diorite, probably a good deal more.

[*Report sent in 3rd August*, 1905.]

* Harker. Researches on Thermal Metamorphism.—Science Progress, 1890.

REPORT ON THE HOMEWARD BOUND, PERSEVERANCE, BON ACCORD, VON MOLTKE, THE DYKE AND MOUNT STANLEY VIEW REEFS, HILLSBOROUGH, WITH PLAN AND SECTION (PLATE XXXIII.).

By E. J. Dunn, F.G.S., Director, Geological Survey of Victoria.

This locality is about 6 miles in an easterly direction from Stanley, in the North-Eastern District, and on the top of the ridge overlooking the valley in which Sutton stands. Sutton lies to the east of Hillsborough, at the foot of the range. About Sutton the country rock is granite, while at Hillsborough the rocks consist of quartzite and micaceous schist, apparently Ordovician beds altered by contact with underlying granite. The Homeward Bound Reef is on the edge of the range, and formerly the quartz was conveyed from the mine to the battery at the eastern foot of the range by a wire-rope tramway. The strike of the reef is about N. 15 deg. E., and the dip is 75 deg. to W. Just south of the main shaft the reef bifurcates, and the eastern branch, with a strike about N. and S. and dip to W. at 80 deg., is known as the Track Reef. Near the shaft the country rocks strike N. 20 deg. W., and dip to W. at about 70 deg. The main shaft is about 410 feet deep on the underlie, but it has fallen together. This shaft should be reopened and deepened, so as to secure ventilation for the tunnel.

At the surface the shoot of gold was about 200 feet long. It is reported that other shoots were worked lower down. The quartz reef is said to have been from 8 to 20 feet in thickness. I remember that when it was being worked in the "sixties" the reef was a wide one. Twenty five feet north of the main shaft a fault cuts off the reef. This fault crosses through the shaft at 200 feet, and the reef is reported to have been worked south of this fault, but nowhere to the north of it. Proceeding northwards, the throw of the fault is to the east. About the main shaft and to the south of it there has been much subsidence, which has extended along the Homeward Bound and the Track Reefs, indicating that very large bodies of material have been removed underground.

For some years past mining has been practically at a standstill in this locality, but a tunnel, commenced some years ago, is being driven so as to intersect any reefs that may live in depth below the workings that were formerly so productive. According to the survey recently made by Mr. A. W. Craven, this tunnel should intersect any reefs at about 200 feet below the old workings. A copy of Mr. Craven's plan has been made by his permission, and accompanies this report.

From this plan it will be seen that the level, extended in a north-westerly direction from the tunnel, is far to the west of where the downward continuation of the Homeward Bound Reef might be looked for, and also that the present north-westerly face of this level is about 100 feet due east of where the downward extension of the Bon Accord Reef should occur. The tunnel has been driven in westward about 700 feet south of where the principal old workings were carried on, instead of directly underneath them. The north-westerly level followed a wall, but in a direction that does not correspond with the strike of the Homeward Bound Reef. For the last 200 feet a reef, gradually increasing in thickness as it was driven on northwards, has been followed. This reef is now 2 feet thick in the face, and as the shoot of gold formerly worked was north of the present face of the reef, I would suggest that it should be followed for another 100 feet to see if it improves in value. From the present extreme face of this north-westerly level a cross-cut should be extended westward, say, for 110 feet, so as to intersect the course of the Bon Accord line of reef.

Returning to the tunnel, near the western end of it, and about 1,100 feet from the mouth, a thin reef was cut between well marked walls, dipping to W. This same reef was cut in the north-western level, 220 feet in from the tunnel. From its strike and dip it looks as though this may be the downward extension of the Track Reef, allowing for the westerly dip. From the level this should be driven on in a northerly direction, but it is nearly 500 feet further north to where the old workings were. That this reef is more likely to be the Track Reef than the Homeward Bound Reef appears from the strike of the latter, which alone would carry it much further to the west than where the thin reef is cut. The westerly dip, of course, would carry the Homeward Bound Reef still further to the west. Taking the strike and dip of the Track Reef, it would, if continued southward and downward, come out not far from where the thin reef occurs.

A cross-cut, driven north-easterly 250 feet from a point in the north-western level, 150 feet from its present face, should intersect the downward course of the Homeward Bound Reef, if it continues downwards, and this would perhaps be the quickest means of getting to that reef or to where it should be. Mr. Craven's plan and sections clearly show the relations of the several workings, shafts, tunnels, levels, &c., to one another.

Appended is a tabulated statement of the yield of gold from this mine.

Table of Quartz Crushed and Gold Obtained from the Homeward Bound Reef.

Year.	Tons of Quartz.	Gold.	Depth in Feet.	Year.	Tons of Quartz.	Gold.	Depth in Feet
		ozs. dwts.				ozs. dwts.	
1865 ...	50	100 0	20*	1873 ...	1,228	429 16	320
,, ...	273	273 0	120	1874 ...	620	248 0	350
1866 ...	1,300	1,235 0	80	,, ...	22	8 16	...
,, ...	184	105 16	...	,, ...	650	235 12	350
,, ...	2,340	2,925 0	90	,, ...	720	297 0	350
,, ...	1,950	1,950 0	100–110	,, ...	392	187 0	380
1867 ..	1,200	814 0	160	1875 ...	490	263 0	400
,, ...	1,200	1,600 0	100	,, ...	390	243 0	400
,, ...	2,000	980 0	240	1876 ...	642	200 14	400
,, ...	2,300	911 0	100	1877 ...	23	37 0	...
1868 ...	1,000	3,000 0	125	,, ...	990	395 16	420
,, ...	1,550	465 0	100	,, ...	990	284 10	420
,, ...	1,500	1,125 0	100	,, ...	620	186 0	420
,, ...	1,700	595 0	...	1878 ...	300	52 0	420
1869 ...	1,900	665 0	120	,, ...	208	62 8	170
,, ...	2,000	900 0	140	,, ...	308	77 0	200
1870 ...	2,400	960 0	200	,, ...	300	75 0	170
,, ...	800	400 0	...	1879 ...	40	12 0	
,, ...	2,642	990 15	...	,, ...	310	108 10	40
1871 ...	560	196 0	100	,, ...	130	54 3	40
,, ...	85	29 15	100	1880 ...	350	52 10	...
,, ...	838	293 6	160	,, ...	300	37 10	...
,, ...	588	235 4	200	1888 ...	200	233 3	260
1872 ...	340	119 0	220	,, ...	180	303 0	250
,, ...	1,060	371 0	...	1890 ...	379	164 10	400
,, ...	900	315 0	250	1892 ..	26	24 3	...
,, ...	200	70 0	310	1893 ...	67	22 0	...
1873 ...	250	87 10	320†				
,, ...	1,150	402 10	320	Total ...	45,135	26,407 17	...

* Reef was 4 feet wide.

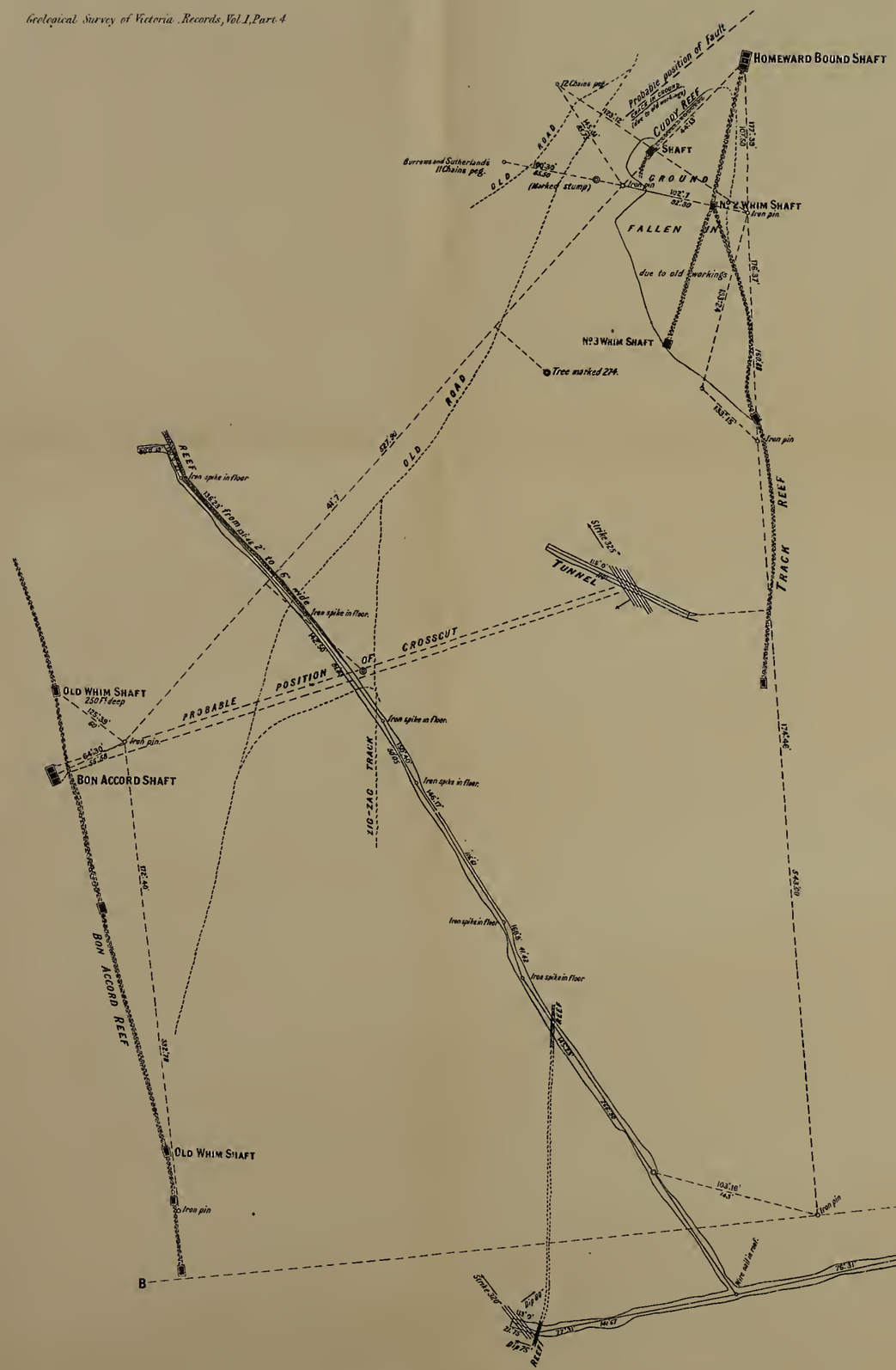
† Reef was 5 feet wide.

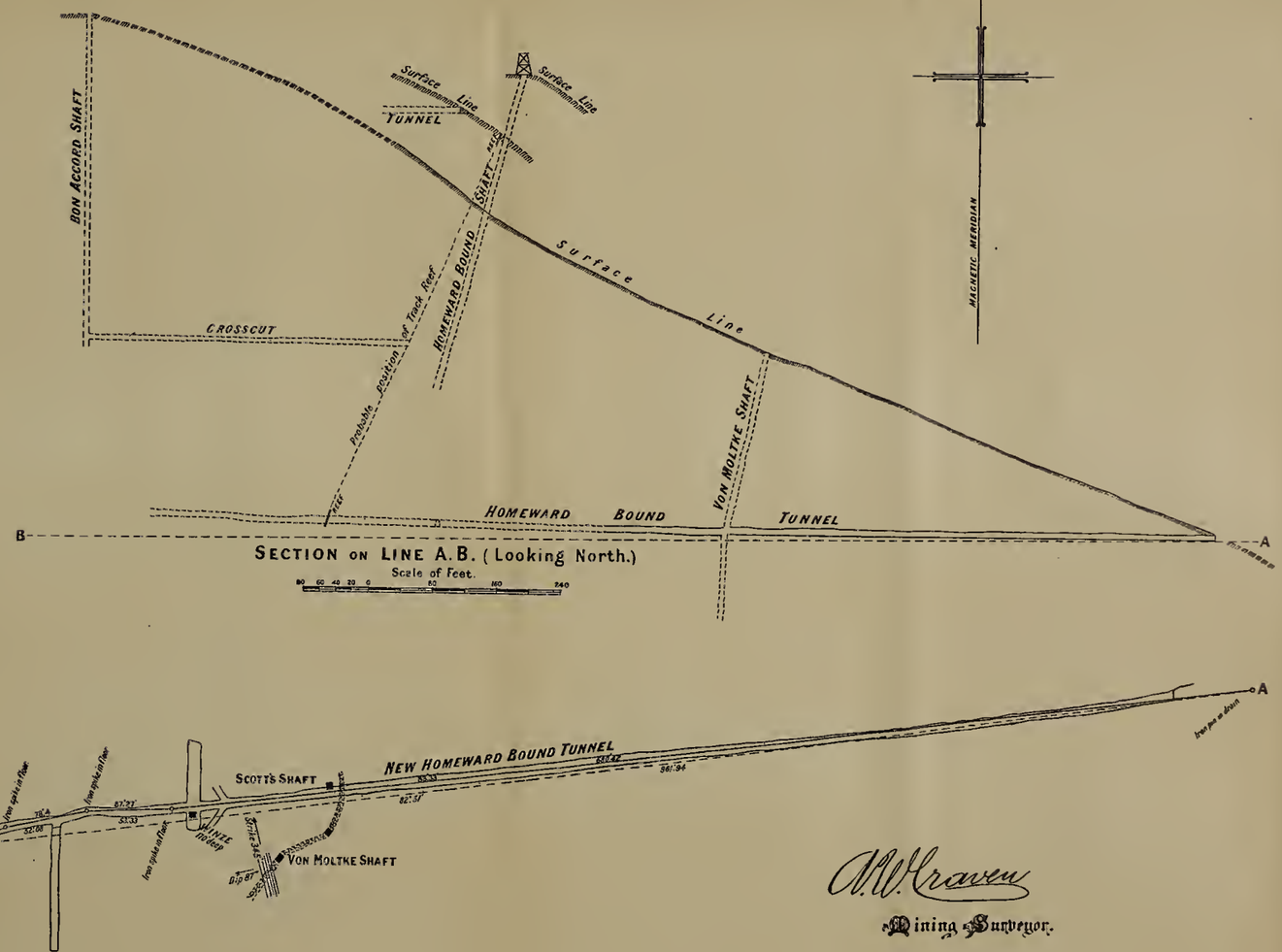
NEW HOMEWARD BOUND G.M.Co N.L.

HILLSBOROUGH.

Scale of Feet.

40 20 0 40 80 120

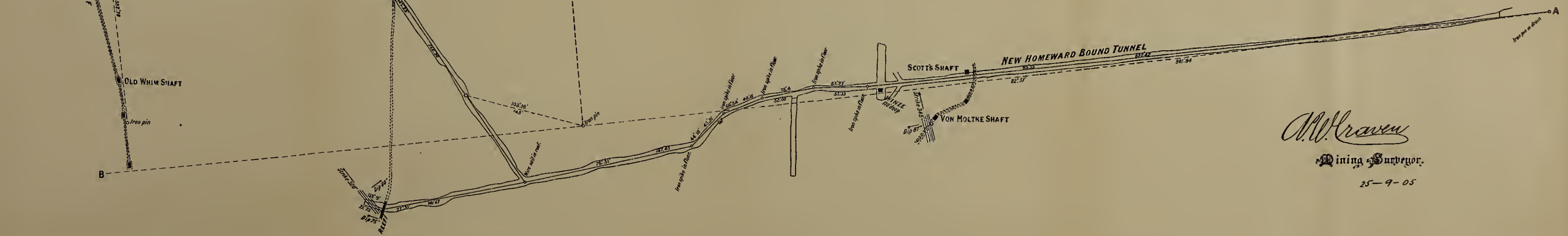




SECTION ON LINE A.B. (Looking North.)

Scale of Feet.

80 60 40 20 0 80 160 240



A. W. Craven

Mining Surveyor.

25—9—05

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NATURAL HISTORY

Perseverance Reef.

About ¼ mile north-west from the Homeward Bound Reef is the Perseverance Reef. The country rock is micaceous schist and quartzite (altered Ordovician strata). A shaft has been sunk 150 feet to the level of a tunnel that has been driven in from the northern side of the ridge. The reef strikes N. 15 deg. E., and dips to west at 75 deg. The reef here was from 1 foot to 1 ft. 6 in. in thickness, and was worked to a depth of 100 feet. The shoot of gold was about 100 feet in length at the surface and 40 feet at the bottom of the workings, and had a pitch southward. Much galena and iron pyrites occurred in the quartz. Strike of country rock is about N. and S., and dip about 78 deg. to E., so that the reef crosses the country at a small angle. This mine was worked about twenty years ago, and the returns are said to have ranged from 4 ozs. to 10 dwts. of gold per ton of stone.

Bon Accord Reef.

The shaft is stated to have been sunk to 400 feet, and a cross-cut driven about 400 feet towards the Homeward Bound Reef. If the cross-cut has been driven in the direction, and for the length stated, it should be within a very short distance of the Homeward Bound Reef. The dip of the Bon Accord Reef is 80 deg. to W. and the thickness of quartz is 2 to 4 feet. The country rock is highly indurated sandstone, &c.; hornfels occurs in bands and small quartz veins ramify through the country rock. This mine was worked by an English company up to about five years ago. The extreme north-western face of the tunnel now being driven is within about 100 feet of where the downward continuation of the Bon Accord Reef should be cut. This 100 feet should be driven due west for the purpose of intersecting the reef.

Table of Quartz Crushed and Gold Obtained from the Bon Accord Reef.

Year.	Tons of Quartz.	Gold.	Depth in Feet.	Year.	Tons of Quartz.	Gold.	Depth in Feet.
		ozs. dwts.				ozs. dwts.	
1866 ...	200	150 0	...	1882 ...	216	108 0	...
,, ...	132	99 0	...	,, ...	101	52 10	...
,, ...	235	188 0	...	1883 ...	158	142 4	150
1867 ...	383	318 10	...	1884 ...	107	103 1	130
,, ...	212	88 0	...	,, ...	176	89 17	150
,, ...	300	130 0	80	,, ...	182	136 12	165
,, ...	305	178 0	100	1885 ...	43	18 4	160
1870 ...	380	100 0	...	,, ...	113	57 6	160
1871 ...	300	105 0	100	,, ...	64	76 16	170
,, ...	280	140 0	80	1886 ...	150	186 13	200
,, ...	220	160 10	80	,, ...	150	340 0	300
1872 ...	180	68 0	..	1887 ...	112	187 10	240
,, ...	250	62 10	70	,, ...	194	264 12	250
,, ...	170	25 10	70	,, ...	117	204 15	230
1873 ...	80	64 0	80	1888 ...	156	215 0	260
,, ...	130	24 10	50	,, ...	194	264 12	250
,, ...	21	5 5	40	1889 ...	156	241 16	300
1874 ...	110	55 18	50	1890 ...	244	350 0	350
1876 ...	42	14 14	...	,, ...	140	182 2	350
1881 ...	104	15 12	...	,, ...	144	129 12	500
,, ...	114	74 2	80				
1882 ...	120	60 0	...		7,185	5,378 1	...

Von Moltke Reef.

This is situate on the eastern slope below the Homeward Bound Reef, and right over the tunnel with which a shaft connects. This shaft is about 200 feet deep. The strike of the reef is about N. and S., but very tortuous, apparently displaced by faults; the dip is to the W. The country rocks strike N. 15 deg. W., dip 87 deg. to W., and pitch 7 deg. to N. The quartz worked was from 6 inches to 2 feet thick.

"The Dyke."

On the Mount Stanley Road, half a mile from its junction with the road from Stanley to Hillsborough, an outcrop of granite occurs on the southern side of the road, while surrounding it are altered sandstones—much indurated Ordovician beds, apparently altered by contact with the granite mass. Most of the granite outcrop is extremely hard, but the northern portion is decomposed. In the softer portion there are several small quartz veins, ranging from ½ inch to 3 inches in thickness. These have been worked to shallow depths in several places, and one shaft has been sunk on such a vein for 60 feet in depth. The extreme N.E. corner of the outcrop has been trenched for a few feet in depth, in following these small quartz veins, but apparently they did not contain sufficient gold to be worked profitably. The strike of most of these quartz veins is nearly E. and W., and they are almost vertical. The locality is interesting, as one in which gold occurs in veins intersecting granite.

Mount Stanley View Reef.

Two hundred yards to the north-west of the granite outcrop above described in the Mount Stanley View Reef in metamorphosed sandstones, &c., worked by Mr. Johnson, of Stanley, and from which £2,000 worth of gold is said to have been taken. The reef has been worked at the surface for a length of about 200 feet, and to a depth of 150 feet. I am informed that the strike of the reef is N. and S. (magnetic), and the dip to W. The quartz was from 6 inches to 2 feet thick. In a northerly direction the course of the reef is traceable for some distance, but there are no workings on it. Southerly the reef is heavily faulted and thrown to the W. Two disjointed blocks have been worked in this direction.

[*Report sent in 9th October*, 1905.]

REPORTS ON GRAPTOLITES, WITH PLATE, FIGURE AND MAP—(PLATE XXXIV.).

By T. S. Hall, M.A. (Melbourne University).

From Turquoise Mine, Ryan's Creek, Myrrhee.

(No. 336-343. Collected by Mr. A. M. Howitt.)

Specimen No. 338 contains examples of *Diplograptus* sp. and No. 339 a *Dendrograptus*, but the state of preservation is too poor to allow of closer determination. There appear to be indefinite traces of graptolites on the other slabs. The evidence submitted is not sufficient to fix the age of the containing rocks. The probability is that they are either Upper Ordovician or else Lower Silurian.

From Turquoise Mine, Mount Avis, Edi.

(Nos. 344-365. Collected by Mr. A. M. Howitt.)

Nos. 344, 345, 347, and 350 are, I think, branches of a member of the family *Dichograptidæ*, perhaps *Didymograptus*. They do not, I think, belong to the family generally known as *Leptograptidæ*, nor to the *Monograptidæ*. They are, however, extremely indistinct. Nos. 346, 353, 356, 358, 360, 361, and 362 are indistinct *Diplograptidæ* of indeterminate character; while Nos. 348, 351, 354, 363, and 365 are referable to *Diplograptus* itself, and 349. 355, 357, and 364 are *Climacograpti*. A second specimen on No. 351 is a *Glossograptus*. I doubt if No. 359 is organic.

In no case can specific determinations be suggested. If the generic determinations of *Didymograptus* and *Glossograptus* be correct, and they seem to be, then the age of the beds may be put down as Upper Ordovician.

From Graptolite Gully, Jordan River, Aberfeldy District. On track, half-a-mile from the Thomson River junction.

(Nos. 366-382. Collected by Mr. William Baragwanath, jun.)

Monograptus seems to be the only genus represented, and, as far as the material allows of careful examination, only one species is present. With some hesitation, owing to the imperfection of the material, I identify this as *M. dubius*, Suess. The following description is drawn up from the specimen figured—Fig. 3:—

Monograptus dubius, Suess.

(compare Wood, E.M.R. in Quart. Jour. Geol. Soc. vol. 56, 1900, p. 454).

Length of figured specimen 29 mm., breadth at 2 mm. from sicular end 2.3 mm. The hydrosome broadens till about the region of the tenth theca, after which the breadth remains almost constant. The back is at first straight and about the level of the third theca becomes slightly concave, then convex, and finally runs on in the same direction as at first. This "monoclinal fold," though slight, is characteristic of the species. Thecæ 9 in. 1 cm., inclined at 25 deg. to 30 deg., and with a hooked denticle. There seems to be a slight difference between the younger and older thecæ, but the specimens are not satisfactory on this point.

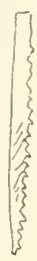

Fig. 3.
Monograptus dubius, Suess.
Nat. size.

The species in Europe has a long range, and probably has so here, but the age of the containing beds is certainly Silurian.

University, Melbourne, July 5, 1904.

From the Northern slope of Mount Easton, on a bearing of 290 deg. (mag.) and a distance of 3 miles from the Thomson-Jordan Junction.

(Nos. 383-389. Collected by Mr. William Baragwanath, jun.)

The present collection contains:—*Dicellograptus affinis* T. S. Hall; *Climacograptus tubuliferus* Lap; *Glossograptus fergusoni* T. S. Hall, besides some other unidentifiable species. The fauna seems rich and would, I think, repay further search.

The age of the beds is Upper Ordovician, while that of the beds immediately to the east, as already reported, is Silurian.

University, Melbourne, Aug. 22, 1904.

From Dingo Creek, on a bearing of 290 deg. (mag.), and a distance of two miles from the Thomson-Jordan junction.

(Nos. 390-416. Collected by Mr. Wm. Baragwanath, jun.)

I have identified the specimens as follows:—

? *Didymograptus*, sp. 403.

Dicellograptus affinis, T. S. Hall; Nos. 396, 403.

D. aff. *forchammeri*, Geinitz; Nos. 400, 401, 411.

D. spp, indet; Nos. 397, 399.

Dicellograptid (? genus; fragments); Nos. 402, 404, 405. 406, 407, 408.

Diplograptus foliaceus, Murch.; Nos. 397, 400, 401, 403, 409 (?), 410 (?), 412 (?), 413 (?).

Diplograptus spp.; Nos. 399, 403, 414, 415, 416.

Climacograptus spp.; Nos. 390, 391, 392, 393, 394, 395, 399, 402, 416.

Indeterminate; No. 398.

The beds are Upper Ordovician, and seem to be fairly rich, though most of the material has suffered from weathering. Possibly more than one zone is represented.

From one mile south (magnetic) from the Thomson-Jordan junction.

(Nos. 417-422. Collected by Mr. Wm. Baragwanath, jun.).

Monograptus cf. *dubius;* Nos. 417, 421.

M. sp.; Nos. 418, 422.

Indeterminate; Nos. 419, 420.

The beds are Silurian.

University, Melbourne, September 21, 1904.

From Dingo Creek, on a bearing of 290 deg. (mag.), and a distance of two miles from the Thomson-Jordan junction.

(Nos. 403, 423-425. Collected by Mr. Wm. Baragwanath, jun.)

Diplograptus foliaceus, Murch.; Nos. 403, 425. Specimen No. 403 was previously examined, but has since been re-split, and this additional species displayed.

Diplograptus, sp. and indeterminate fragments; No. 423.

Diplograptus, sp. indet. and indeterminate fragments. No. 424.

Upper Ordovician.

From one mile S. (mag.) from the Thomson-Jordan junction.

(Collected by Mr. Wm. Baragwanath, jun.)

Monograptus, sp. indet.; No. 426.

Silurian.

From Graptolite Gully, Jordan River, Aberfeldy District, on track half-a-mile from the Thomson River junction.

(Collected by Mr. Wm. Baragwanath, jun.)

Monograptus, sp. indet.; No. 427.
Silurian.

From the northern slope of Mount Easton, on a bearing of 290 deg. (mag.), and a distance of three miles from the Thomson-Jordan junction.

(Same locality as numbers 383-389.)

(Nos. 429-435. Collected by Mr. Wm. Baragwanath, jun.).

Climacograptus bicornis, J. Hall, Nos. 437 (3 examples) and 441, counterpart of No. 437.

Climacograptus, sp.; Nos. 433, 444.
Climacograptus, sp. indet.; Nos. 429, 431.
Diplograptus foliaceus, Murch.; No. 456.
Diplograptus, sp.; Nos. 448, 452, 453 and 454 (counterparts), 461. *D.*, sp., indet.; No. 446.
Diplograptidæ, indet.; No. 457.
Glossograptus, sp.; No. 430.
Dicellograptus affinis, T. S. Hall; Nos. 429, 431 (?), 434.
Dicellograptus elegans, Carr.; Nos. 432, 435, 440.
Dicellograptus, sp.; Nos. 430, 448, 451. *D.*, spp. indet.; Nos. 434, 445, 446.
Leptograptus, sp.; Nos. 436, 438, 439 (counterpart of No. 436), 442, 444, 447, 449, 450, 453, 454, 455, 456, 457, 458, 459, 460, 461.
Indeterminate; No. 443.

There seems to be but one species of *Leptograptus* in the above series, and it is closely allied to, if not identical with, *L. flaccidus*, J. Hall. None of the specimens, however, show the sicular or thecal characters sufficiently clearly for more exact determination. I was at first inclined to regard them as obscure examples of *Dicellograptus*, but a careful examination convinces me that they are *Leptograptidæ*. The specimens of *C. bicornis* are typical, and not the Stockyard Creek (N.S.W.) variety.

The age of the beds is clearly Upper Ordovician, and not far removed from the other beds of that age herein dealt with.

From the Cornish line of Reef, Daylesford.

(Nos. 462-478. Collected by Mr. W. H. Ferguson).

Didymograptus bifidus, J. Hall; Nos. 462, 463, 473 (?).
Tetragraptus quadribrachiatus, J. Hall; Nos. 463, 469.
T. fruticosus, J. Hall; Nos. 464, 465, 468 (a form with two stipes only), 471, 474, 478.
T. bryonoides, J. Hall; Nos. 465, 476, 478.
Phyllograptus typus, J. Hall; Nos. 465, 467, 477.
Indeterminate; Nos. 466, 472, 473, 475.
Crustacean; No. 470.

The age is Lower Ordovician (Bendigonian horizon), and, as is shown by the presence of *Didymograptus bifidus*, the beds are at the top of the Bendigo series and correspond to those displayed in Wattle Gully, Chewton.

FROM DAYLESFORD DISTRICT.
(Collected by Mr. W. H. Ferguson).

Amelia Company's waste-tip, Trentham.

Indeterminate; No. 479.

Little Snake Reef, Trentham.

Tetragraptus quadribrachiatus, J. Hall; No. 480.
Lower Ordovician; horizon uncertain.

The Springs, Daylesford.

(Nos. 481, 482).

Tetragraptus fruticosus, J. Hall; No. 481.
Tetragraptus bryonoides, J. Hall (?); No. 482.
Phyllograptus typus; J. Hall (?); No. 482.
Lower Ordovician; Bendigo horizon.

The Falls, Trentham.

(Nos. 483, 484).

Didymograptus, sp. indet.; No. 484.
Indeterminate; No. 483.
Ordovician; probably Lower.

Bullarto.

Didymograptus caduceus, Salter (medium size); No. 485.
Lower Ordovician; Castlemaine horizon.

Bullarto, Railway Cutting.

Phyllograptus angustifolius, J. Hall (?); No. 486.
Lower Ordovician; probably Castlemaine horizon.

Bullarto, Callaghan and Reilly's mine.

Didymograptus, sp.; No. 487.

This species is as yet undescribed, but is common at Diamond Hill, Bendigo, and I think ranges a good deal.

Lower Ordovician; horizon uncertain.

University, Melbourne, April 3, 1905.

From spur between Boys and Bell Creeks, on track along Thomson River, 4½ miles below the Jordan junction.

(Nos. 488-521 and 539-546. Collected by Mr. Wm. Baragwanath, jun.)

With the exception of Nos. 504, 540 and 541, which are indeterminate, all the slabs show specimens of *Monograptus*, but in no case are they sufficiently well preserved for determination. Only very rarely can the characters of the thecæ be even indistinctly recognised. The virgula is, however, almost always visible as a shallow semi-cylindrical groove, and serrations can be seen on the side opposite to this. There is a general agreement in shape in practically all the specimens. They are stout and have a scarcely perceptible sigmoidal curvature on the virgular side. Nos. 490, 496, 539, and 546 appear to belong to the sub-genus *Pristiograptus*.

Nos. 497, 498, 507 (?), 517, and 518 have thecæ of the "priodon" type. The other specimens are only generically determinable, and I can detect no trace of any other graptolite genus among the hundreds of examples present on the slabs.

Specimen 506, in addition to *Monograptus*, shows a fragment of an *Orthoceras*, and No. 508, also in addition to *Monograptus*, displays an indeterminate organism. The age is Silurian and evidently close to that of the Alexandra graptolite beds.

From spur south-west of Blaze XIII. at Thomson River, 5½ miles from the Jordan junction.

(Nos. 522-538, 547 and 548. Collected by Mr. Wm. Baragwanath, jun.)

Nos. 522-538 are specimens of *Monograptus*, similar to Nos. 488-521 and 539-546. None are specifically determinable. The age is Silurian.

Nos. 547 and 548. The locality given for these two specimens is near that of Nos. 522-538, but I find a difficulty about them. No. 547 is a *Monograptus*, and is therefore a Silurian form, whereas No. 548 is a *Didymograptus*, having the aspect of *D. caduceus*. The cast of the sicula can be clearly seen and the reverted apertural denticles of the thecæ are visible. Of the generic position of the fossil there can be no question. The matrix, an indurated blue micaceous mudstone, appears the same as that of many of the other specimens from the same spur, but I feel convinced that the presence of this Lower Ordovician type in association with *Monograptidæ* is an error due to human agency.* With the exception of this fossil the whole of the rest of the fossils (Nos. 522-538 and 547) are of Silurian age.

From Geological Quarter sheet, No. 34, S.W. Wood's Point.
(Collected by Mr. O. A. L. Whitelaw.)
(Nos. 552-614.)

Unfortunately they are in no case specifically identifiable.

From No. 10 spur on the Main Divide, between Spring Hill and Mount Selma.
(Nos. 552-555.)

These are referable to *Diplograptus*. Age uncertain, but either Lower Silurian or Upper Ordovician.

From No. 12 Blaze, on the Main Divide.
(Nos. 556-592.)

No. 559 I can see nothing on, but all the others are apparently referable to *Diplograptus*. Age uncertain, but either Lower Silurian or Upper Ordovician.

From Black River, near junction with Ten Mile Creek.
(Nos. 593-614.)

No. 601 is apparently a fragment of a *Dicranograptid*. The thecæ are visible, and apparently are twisted laterally, while the dorsal wall is thickened. The thecæ, as far as can be made out, are not those of

* In the face of Mr. Baragwanath's personal assurance that there was no confusion of localities in these two specimens, but that both came from the same block of stone, I have requested permission to re-examine them. I see no reason to alter my opinion as to their generic position. I have, moreover, explained the case to Mr. F. Chapman, A.L.S., and he has examined the supposed *Didymograptus*. He allows me to say that he agrees with my identification. Further specimens are urgently required from this locality as the inferences to be drawn are too important to rest on a couple of very indistinct fossils.

a *Monograptus*, while the dorsal thickening is plate-like as it penetrates the rock perpendicularly to the bedding. It is then not a virgula such as is present in *Monograptidæ*. The specimen is very indistinct, but I feel fairly sure that it represents a *Dicranograptid*, and is, therefore, indicative of Upper Ordovician age.

Nos. 596 and 612 are *Diplograptus*, sp. cf. *murchisoni*. Nos. 593, 595, 597, 600, 605, 606, 607, 608 are *Diplograptus* spp. Nos. 596, 597, 598 (?), 603, and 613 (?), are *Climacograptus* spp. Nos. 594, 599, 602, 604, 609, 610, and 614 are indeterminate.

The presence of the genera *Diplograptus* and *Climacograptus* alone is not sufficient to fix the age definitely. But it might be either Lower Silurian or Upper Ordovician. The probable presence of a *Dicranograptid* and of a *Diplograptus*, which might be *D. murchisoni*, both point to Upper Ordovician, and I have but small doubts that is really the age of the beds. It may be put on record that the slabs are in places fairly crowded with specimens, so that hundreds must be present in the collection, but there is no sign of a *Monograptus*, or of any compound form other than the nearly straight flexuous fragment identified as a *Dicranograptid*. The specimens are all much distorted by cleavage, which is parallel to the bedding and well developed.

University, Melbourne, June 26, 1905.

From Bendigo.

(Nos. 615-667. Collected by Mr. H. S. Whitelaw).

From the Concord Company's lease.

(Nos. 615-636A).

Didymograptus, sp. indet.; No. 626.

Tetragraptus serra, Brong. (?); No. 628 (badly preserved).

Tetragraptus fruticosus, J. Hall. Three-branched form—Nos. 615, 616, 619, 624, 625, 626, 633, 634; four-branched form—No. 633; doubtful form—Nos. 622, 628, 629, 630, 631, 636.

Phyllograptus typus, J. Hall. Nos. 617, 621, 622, 625, 629, 631, 632 (?).

Indeterminate; Nos. 618, 620, 623, 627, 635, 636A.

Of the three species identified, *T. fruticosus* is confined to the Bendigo series, and is its typical fossil. *Tetragraptus serra* and *Phyllograptus typus* both pass up into the Castlemaine series.

From between Lansell's 180 mine and the Victoria Reef mine.

(Nos. 637-644).

Tetragraptus fruticosus, J. Hall. Three-branched form—Nos. 637, 639, 640, 641, 642, 643, 644; four-branched form—No. 641.

Tetragraptus pendens, Elles; No. 638.

Dichograptus octobrachiatus, J. Hall; Nos. 639, 642, 644 (in all 9 or 10 examples).

Goniograptus, sp. indet.; No. 642.

Phyllograptus, sp. indet.; No. 642.

Dichograptus octobrachiatus seems commoner than at most Bendigo localities.

From Hustler's line of reef.

(Nos. 645-669).

Didymograptus, spp.; Nos. 646, 654, 661, 667.

Tetragraptus fruticosus, J. Hall. Three-branched form—Nos. 645, 653, 655, 660, 662, 665; four-branched form—Nos. 645, 647, 649, 653, 660, 663; doubtful—Nos. 646, 654, 657, 661.

Tetragraptus approximatus, Nicholson; Nos. 649, 650, 659, 660, 662, 664, 666.

Tetragraptus quadribrachiatus, J. Hall; Nos. 645, 647, 650, 657.

Tetragraptus bryonoides, J. Hall; No. 658.

Tetragraptus serra, Brong.; Nos. 656, 659.

Dichograptus octobrachiatus, J. Hall; No. 665.

Dendrograptus, sp.; No. 649.

The most interesting point about this collection is the occurrence of *Tetragraptus approximatus* along the Hustler's line, near Hustler's Hill. This has not been recorded previously from Bendigo, and in spite of the large amount of material from the district I have examined at various times, I had not recognised its presence. We have in this species, I think, an indication of the possibility of zoning the thick Bendigo series, as evidently diversity in the fossils exists. *T. approximatus* has previously been found near Dromana, by Mr. Ferguson, and the rocks there I had indicated as of Bendigonian age. All the other species here recorded from the Hustler's line are common Bendigonian species and, excepting the restricted *T. fruticosus*, pass up into higher beds.

University, Melbourne, June 19, 1905.

From longitude 146 deg. 13 min. 45 sec.; latitude 37 deg. 40 min. 30 sec.; quarter sheet 22 N.W.—2 miles N.W. of Mount Easton, at locality 7 on map.

(Nos. 668-686, marked F 2'2, Collected by Mr. Wm. Baragwanath, jun.)

The following determinations have been made:—

Leptograptus flaccidus (J. Hall), No. 681.

Dicellograptus complanatus, Lap., var. *ornatus* (Elles and Wood). Nos. 670, 686.

Dicellograptus, sp., Nos. 670, 674, 677, 686.

Diplograptus carnei (T. S. Hall), Nos. 673, 674, 678, 679, 680, 682.

Diplograptus, sp., Nos. 675, 679, 684.

Climacograptus mensoris, n. sp., Nos. 669, 671, 674 (type), 679, 683, 686.

Climacograptus, spp., Nos. 670, 671, 672, 681

Retiolites caudatus (T. S. Hall), No. 681.

Indeterminate, Nos. 668, 676, 685.

Descriptions and Remarks.

Leptograptus flaccidus (J. Hall).

Plate xxxiv., Fig. 1.

One specimen only which agrees well with those from Mount Easton, recorded below.

Dicellograptus complanatus (Lapworth).

var. *ornatus* (Elles and Wood).

Plate xxxiv., Fig. 5.

Three specimens which appear identical with the species as described and figured by Miss Elles and Miss Wood.

Diplograptus carnei (T. S. Hall).

Plate xxxiv., Fig. 13.

This species is represented by a large number of specimens which have been compared with specimens from the type locality in New South Wales.

Climacograptus mensoris, n. sp.

Plate xxxiv., Fig. 5.

Polypary parallel sided, and abruptly pointed towards the base. Length 15 mm., breadth 1.5 mm. Thecæ 10 in 1 cm. Virgula visible in the body of the polypary, free for 10 mm., slightly expanding towards the anti-sicular end. One specimen (No. 671) shows a very short virgella. [Type No. 674.]

Loc. Longitude 146 deg. 13 min. 45 sec. E., latitude 37 deg. 40 min. 30 sec. S., 2 miles N.W. of Mount Easton; collected by W. Baragwanath, jun. [6 examples.]

Retiolites caudatus (T. S. Hall).

One specimen fairly well preserved, and agreeing with those from Stockyard Creek, New South Wales, the type locality.

Summary.

Five species are identified. Of these, two, *Diplogr. carnei* and *Retiolites caudatus*, occur at Stockyard Creek in New South Wales, near the Croajingolong border. These point to a fairly close agreement of horizon, especially as *R. caudatus* has, as yet, not been found elsewhere. At present we cannot speak more definitely. *Climacogr. mensoris* is new and striking in character. I have not seen it elsewhere.

The two extra Australian species are *Leptogr. flaccidus* and *Dicellograptus complanatus* var. *ornatus*. These are not associated in Scotland, but belong to different horizons. The former species, I feel sure, is correctly determined, as will be seen below in dealing with the Mount Easton collection, but of the *Dicellograptus* I cannot speak with the same confidence.

The beds containing the fossils are Upper Ordovician.

University, September 28, 1905.

From three-quarters of a mile north-west of Mount Easton.

(Nos. 687-790; marked F23. Collected by Mr. Wm. Baragwanath, jun.)

The following is a list of the species determined:—

Leptograptus flaccidus (J. Hall), Nos. 712 (fig.), 724, 726, 728, 732, 778.

Dicellograptus elegans (Carruthers), Nos. 689, 691, 701, 702, 713 (fig.), 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 725, 727, 729, 730, 731, 734, 735, 742, 763, 765, 768, 774.

Dicellograptus, sp., 701, 715, 731, 760, 763, 765.

Dicranograptus ramosus (J. Hall), var. *semispinifer* var. nov., Nos. 693, 707, 708, 709 (type), 710, 711, 755, 757, 770, 779.

Dicranograptus hians, T. S. Hall, Nos. 704 (?), 705, 717, 737 (?), 787.

Dicranograptus nicholsoni, Hopkinson, Nos. 766, 768.

Dicranograptus, sp., No. 739.

Diplograptus ingens, n. sp., Nos. 687, 688, 689, 691 (?), 697, 723, 725 (?), 734, 738, 739, 740, 741 (type), 742, 743, 745 (?), 746, 747, 748, 760, 770, 780.

Diplograptus foliaceus (Murchison), Nos. 699, 715, 731, 736, 744, 749, 753, 754, 755, 756, 759, 762, 764.

Diplograptus, cf. *aculeatus* (Lapworth), No. 755.

Diplograptus, spp., Nos. 694, 698, 700, 711, 716, 718, 734, 745, 750, 755, 757, 758, 760, 761, 763, 769, 771, 775, 777, 788.

Diplograptus (*Orthograptus*) *quadrimucronatus* (J. Hall), Nos. 706 (fig.), 711, 720 (?), 723, 732, 751, 758 (fig.), 767, 779.

Diplograptus (*Orthograptus*), sp., No. 752.

Cryptograptus tricornis (Carruthers), Nos. 700, 702, 743, 760, 766, 768, 776.

Climacograptus baragwanathi, n. sp., Nos. 694, 699, 716, 720, 723 (type), 731 (?), 760, 768.

Climacograptus bicornis (J. Hall), Nos. 701, 704, 712, 713, 714, 716, 718, 722, 723, 724, 734, 741, 742, 749, 750, 754, 755, 758, 760, 765, 768, 778, 779, 784, 785 (fig.), 788, 789.

Climacograptus, spp., Nos. 692, 694, 695, 703, 741, 750, 757, 758, 772, 775, 776, 781, 782, 786.

Glossograptus, sp., Nos. 735, 766, 776.

Retiolites, sp., No. 733.

Indeterminate, 690, 696, 773, 783, 790.

Descriptions and Remarks.

Leptograptus flaccidus (J. Hall).

Plate xxxiv., Fig. 1.

Hydrosome slender and somewhat flexuous. Branches reaching a length of 8 cm., diverging at about 180 degrees, and usually reverted. Breadth of branches in sicular region 0.3 mm.; gradually widening to .7, or more, at their free ends. Sicula slender, about 1.5 mm. long. Thecæ 10 in 1 cm., slender, somewhat mucronate, inclined at a very low angle, ending opposite a thick-rimmed excavation at the base of the next succeeding theca.

The species has not previously been recognised in Australia. [19 examples.]

Dicellograptus elegans (Carruthers).

Plate xxxiv., Fig. 2.

(*See* Hall, T. S., Proc. Roy. Soc. Vic. 18 (1905), p. 23, pl. 6, fig. 5.)

Some examples are of considerable size, the separate branches being about 15 cm. long, and crossing one another at about 10 cm. from the sicula. The spiral twisting of the hydrosome about the sicular axis, which would bring this appearance about in flattened specimens, may be traced in the varying angles at which the thecæ are embedded, even in small specimens. In one place they are on the outer side of the curve, and in another on the inner side. [63 examples.]

Dicellograptus, sp.

There are nine or ten small specimens present which somewhat resemble *D. sextans;* but the branches seem too slender, and no details are preserved.

Dicranograptus ramosus (J. Hall), var. *semispinifer*, var. nov.

Plate xxxiv., Fig. 4.

Hydrosome with a biserial portion from 16 to 20 mm. long, gradually expanding from a somewhat pointed sicular region, till at about 7 mm. it reaches a width of 2 mm. Thence to the bifurcation it maintains an even width. Branches diverging at 25 degrees; straight, with a width

of 1.5 mm. maintained throughout. The biserial portion bears about 10 thecæ in 1 cm., of which about 12 are spined. Thecæ strongly curved inwards and laterally. The variety is intermediate between the typical form and var. *spinifer* Elles and Wood. From the former it differs by the presence of more than one spine on each side of the biserial portion, by the greater width of this part, and by the fact that it does not broaden continuously from sicula to bifurcation. From var. *spinifer* it differs in not having all the thecæ of the biserial portion spined, and in this part not being ovate in outline. [10 examples.]

Dicranograptus hians, T. S. Hall.

(*See* Proc. Roy. Soc. Vict. 18 (1905), p. 24, pl. 6, fig. 6).

[3 complete, and 2 imperfect, doubtful examples].

Dicranograptus nicholsoni, Hopkinson.

(*See* Hall, T. S.; Proc. Roy. Soc. Vict. 18 (1905), p. 24, pl. 6, fig. 7).

[4 examples].

Diplograptus ingens, sp. nov.

Plate xxxiv., Fig. 7.

Hydrosome very large, expanding from a pointed sicular region for about 15 mm., when it reaches a width of 6 or 7 mm. Thence it very slowly narrows, and at about 40 mm. from the sicula is about 4 or 5 mm. wide. It then gradually increases to a width of 5 or 6 mm. The anti-sicular end is abruptly truncate. Virgula distinct, but slender; free for about 1 mm. Virgella about 1 mm. long. Thecæ 9 or 10 in 10 mm. They appear to have the shape of those shown by Lapworth in his *D. perexcavatus*.* They consequently at times show a series of triangular denticles with the apertural margins normal to the virgula, while in other cases on the same specimen the outer margin is hollowed out much as in *Climacograptus*. The thecæ as a whole are inclined at about 30 or 40 deg.

None of the specimens show further details. The great size of the species is not due to extreme compression, as examples of other species on the same slabs are not abnormal.

There are some slightly smaller specimens present with parallel sides and with an extreme width of 4 or 5 mm., which I think are merely varieties of this form.

[55 examples].

Diplograptus foliaceus, Murchison.

The variety occuring here has about 13 thecæ in 10 mm., as opposed to 8 or 9 in the New South Wales examples I have elsewhere figured and described; otherwise the specimens agree.

[72 examples].

Diplograptus cf. aculeatus, Lapworth.

A single example agrees well with Lapworth's species, but is not distinct enough for exact determination, and the sicular and anti-sicular ends are imperfect. The thecæ number nearly 11 in 10 mm. (28 in an inch), thus agreeing with Lapworth's maximum. Their shape is not very clearly shown. Doubt as to the identity of the present specimen arises from the fact that the test is fairly thick and not of the extreme tenuity described by Lapworth.

* Ann. Mag. Nat. Hist. ser. V. (1880), pl. 5, fig 25d.

Diplograptus spp.

There are a large number of specimens of other species present, but most are small and not well preserved. They may be young.

Diplograptus (*Orthograptus*) *quadrimucronatus* (J. Hall).

Plate xxxiv., Figs. 10, 11.

Hydrosome reaching a length of about 40 mm. and a width of 4 mm., parallel sided and tapering to the sicular end, the nature of which is not shown in the present specimens. Before compression the hydrosome appears to have been quadrangular in section. Thecæ straight, quadrangular in section, usually preserved in an almost scalariform manner on one side of the virgula, while the series on the other merely indents the margin. A strong spine developed on each side of the aperture, those on one side projecting from the present free edge—those on the other, which are barely visible, now lying near the virgula. At the level of about the 7th or 8th thecæ are four prominent spines about 2.5 mm. long.

[About 10 examples].

Cryptograptus tricornis (Carruthers).

(*See* Hall, T. S.; Proc. Roy. Soc. Vict. 18 (1905), p. 22, pl. 6. fig. 4).

These specimens agree perfectly with those I have from Mt. Wellington.

[7 examples].

Climacograptus baragwanathi, n. sp.

Plate xxxiv., Fig. 6.

Hydrosome tapering for about 2 cm., where it is about 2 mm. in width. Thence on it is parallel sided, and may reach a total length of 50 mm. Virgula distinct, and close to it appears to be another solid rod which runs the length of the hydrosome. Virgula free for 6 or 7 mm. Thecæ 10 in 1 cm., only shown in the present specimens in a scalariform manner. Attached to the sicular end is a network of fine threads, which is ill-defined in shape, but rather transversely elongate.

Lapworth has figured some Diplograptidæ in the "Catalogue of Western Scottish Fossils," and in his paper on the Graptolites of Co. Down, with vesicles attached to the sicular end, but all are shown as having well defined margins. In the present species all that is visible is a network of apparently irregularly branching and anastomosing fibres, resembling the hydrorhiza of a recent hydroid, or the anchoring organ of some of the polyzoa. I offer no suggestion as to its use.

Dedicated to Mr. Wm. Baragwanath, jun., who has done such good geological work in the district whence these fossils came.

[5 examples].

Climacograptus bicornis (J. Hall).

Plate xxxiv., Fig. 8.

The specimens are typical.

[36 examples].

Glossograptus, sp.

Plate xxxiv., Fig. 9.

Four examples of a *Glossograptus* are present, but all are imperfect.

Retiolites, sp.

Plate xxxiv., Fig. 12.

Two, or perhaps three or four, specimens of a species of *Retiolites* are present in close contact on one slab. A prolonged virgula is visible as in *R. caudatus*, T. S. Hall, but the hydrosome seems too narrow for that species, though its affinities are clearly with it.

This is the best collection that has been submitted to me by the Department alike in number of specimens and species, and in the state of their preservation.

The beds are of Upper Ordovician age, and judging by the species occurring in Britain as well, are more closely allied to the Lower Hartfell series of that country than to any other. Closer comparison is not I think yet possible, and the relationships to the beds in the neighbourhood of Mt. Easton must be worked out in the field. The fairly large number of species in the collection enables us to fix a definite horizon, and upon this further work may be based.

University, Melbourne, Sept. 28, 1905.

Plate xxxiv.

Explanation of Figures.

1. *Leptograptus flaccidus* (J. Hall). [712].
2. *Dicellograptus elegans* (Carruthers). [713].
3. *Dicellograptus complanatus*, Lap. var. *ornatus*, Elles and Wood. [686].
4. *Dicranograptus ramosus* (J. Hall). var. *semispinifer*, var. nov. [706].
5. *Climacograptus mensoris*, n. sp. [674].
6. *Climacograptus baragwanathi*, n. sp. [723].
7. *Diplograptus ingens*, n. sp. [741].
8. *Climacograptus bicornis* (J. Hall). [785].
9. *Glossograptus*, sp. [766].
10. *Diplograptus* (*Orthograptus*) *quadrimucronatus* (J. Hall). [706].
11. ,, ,, ,, ,, [758].
12. *Retiolites*, sp. [733].
13. *Diplograptus carnei*, T. S. Hall. [679].

The figures are all natural size. The numbers in brackets are those attached to the specimens figured, in the collection of the Department of Mines.

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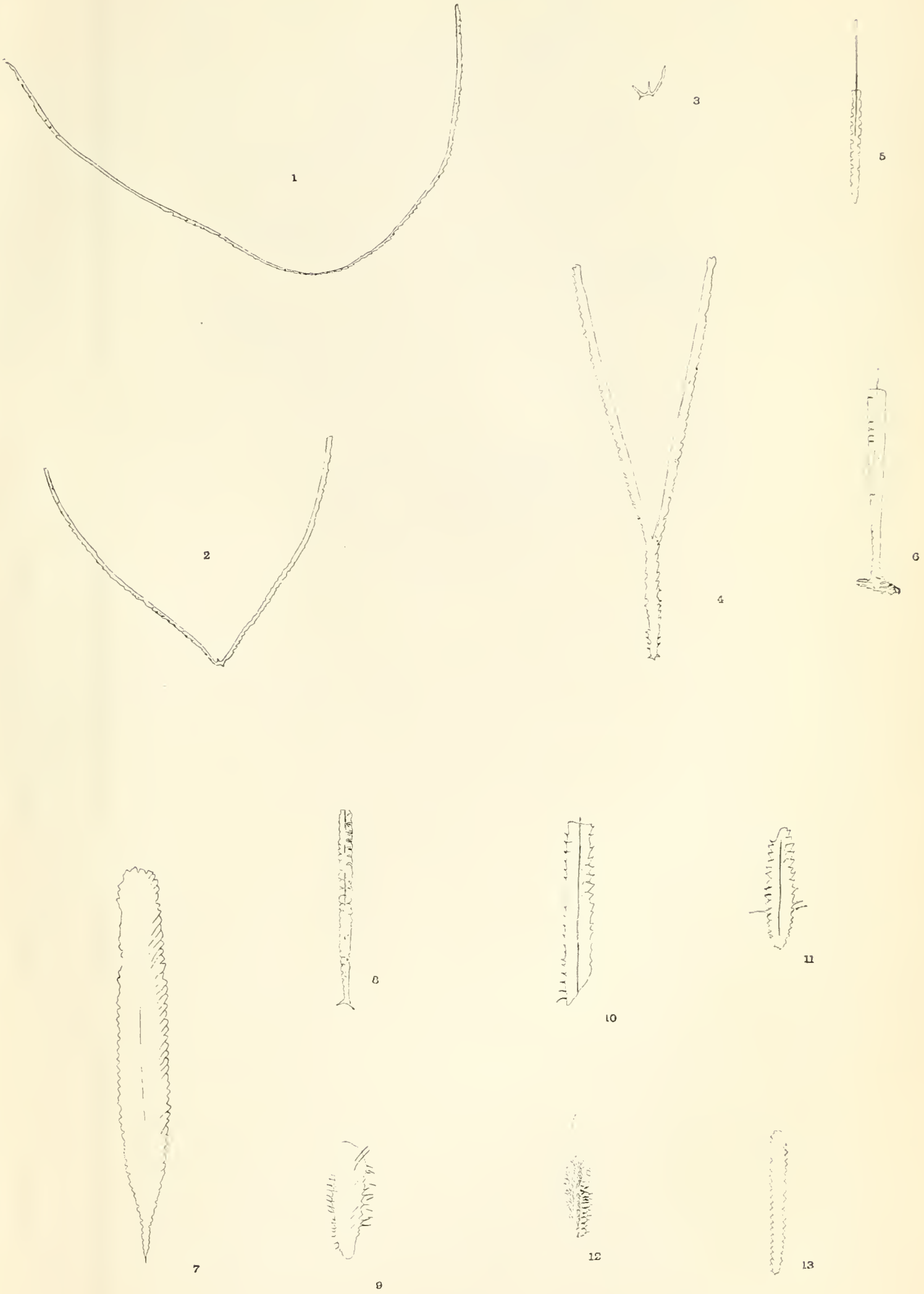
GEOLOGICAL SURVEY OF VICTORIA, RECORDS, VOL. I., PART 4 (PLATE XXXIV.).



UPPER ORDOVICIAN GRAPTOLITES FROM NEAR MT. EASTON, UPPER THOMSON RIVER DISTRICT.

BRITISH MUSEUM
G. D.
NATURAL HISTORY

Sketch Map of the
MT BAW BAW-BLACK RIVER DISTRICT
GRANO-DIORITE
BOUNDARY OF GRANO-DIORITE
1. Gully Jordan River
2. Northern range of Mt Easton
3. Upper creek Thomson River
4. Ridge between tributaries from Thomson and Jordan
5. Spur between Boys and Bell Creeks Thomson River
6. Thomson River 3 miles below Jordan confluence
7. Two miles west of Mt Easton
8. Three quarters of a mile north west of Mt Easton
A. Yarra Track 7 miles south west of Mt Matlock Kelly's Hut
B. Main Divide between Spring Hill and Mt
C. Blaze No 12 on the Main Divide
D. Black River west junction with Top
NEW SOUTH WALES
MURRUMBIDGEE RIVER
LACHLAN R
Narrandera
Junee
Jerilderie
Deniliquin
Moulmein
MURRAY R
GUMBOWER
GLADSTONE
BENDIGO
RODNEY
DALHOUSIE
TALBOT
ANGLESEY
MONMONGATTA
TANJIL
TAMBO
CROAJINGOLONG
GRENVILLE
PORT PHILIP BAY
MORNINGTON
BULN-BULN
POLWARTH
Bass Strait
MAP OF PORTION OF
VICTORIA
Showing localities whence Graptolites referred to in this Part of the Records were obtained.
Localities indicated thus +
Scale of Miles

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NATURAL HISTORY